The Electrical Industry's Weekly Magazine May 16, 1960

# Electrical World

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# 5TH NUCLEAR POWER REPORT

## 8 Reactor Concepts Sprint for Power Goal page 63

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General Electric reports on developments in . . . **NUCLEAR POWER**

# Coming Closer: ECONOMICAL NUCLEAR POWER

**FIVE YEARS AGO** General Electric established its Atomic Power Equipment Department to consolidate the Company's work on commercial applications of nuclear energy. After three years of research and development, the Department set two closely related goals of interest to electric utilities:

- continued improvement of the boiling water reactor, which General Electric research had shown to be the reactor type most likely to bring economical nuclear power fastest, and at least cost
- attainment of competitive nuclear power in high-fuel-cost areas by 1965

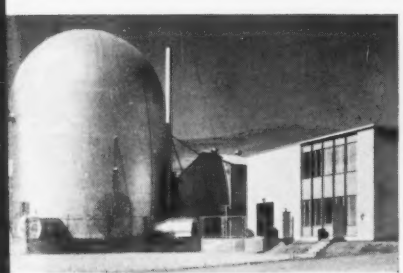
**IN APRIL 1960** an important event symbolized the rapid progress made toward the first goal. Commonwealth Edison's Dresden station, the nation's largest all-nuclear power plant, produced its first power for the Chicago area. Boiling water reactor technology has been advanced considerably by design, construction, and test experience at Dresden.

**DURING THE NEXT FEW YEARS** a series of boiling water reactor power plants will be constructed, each making a significant contribution to the attainment of the second goal, competitive nuclear power. These plants are part of Operation Sunrise, a General Electric technical development program which has already resulted in several innovations with significant cost-cutting potential:

- **Pressure suppression,** which eliminates the need for large spherical containment vessels in some applications
- **Nuclear superheat,** which results in an improved heat rate
- **Internal steam separation,** which eliminates the need for high steam drums and extensive piping

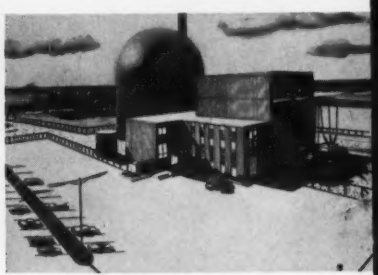
Two 50,000-kw Operation Sunrise plants will be completed by 1962—Pacific Gas & Electric Company's Humboldt Bay station and Consumers Power Company's Big Rock plant. Operating experience gained from these and other evolutionary plants, as well as from Dresden and from General Electric's Vallecitos Boiling Water Reactor, will help cut the cost of nuclear power further.

**IN THE 1970'S** nuclear fuel will achieve conventional status throughout the United States. The co-operation of electric utilities, the Government, and manufacturers toward this end is an indication of a progressive attitude toward technological development, an attitude which will help this country maintain its international prestige and security. For more information on Operation Sunrise, write for publication GED-3750, General Electric Company, Section 604-05, Schenectady 5, N. Y.



**THE VALLECITOS BOILING WATER REACTOR** is part of G.E.'s Vallecitos Atomic Laboratory, the world's largest privately owned nuclear laboratory.

**COMMONWEALTH EDISON'S** 180,000-kw Dresden station, the nation's largest all-nuclear power plant, began supplying power in April, 1960.



**TO BE COMPLETED IN 1962,** this plant of Consumers Power Company will contribute to a rapidly growing boiling water reactor technology.

GENERAL ELECTRIC

# Electrical World

Vol. 153, No. 20 MAY 16, 1960

Published for 86 years for those engaged in the business of generating, transmitting, distributing, or applying electric power


## In This Week's Issue


GENERATION

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*C. D. Wilson, Allis-Chalmers Mfg Co*

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Businessmen's plans to lay out $37.9-billion for new plants and equipment have power consumption implications....p 127

MEETING

**Tells MVEA Energy Studies Are Worth-While**

Kansas City speaker says direct conversion to electricity has power possibilities .....p 144


## Special Report

**5TH NUCLEAR POWER REPORT** .....p 63

Present status of civilian power reactor projects built, building or planned under each of the eight major reactor concepts is here reviewed and related to AEC's 10-year program for the development of economically competitive nuclear power by 1968. Detailed statistics of each prototype power plant and experimental reactor in the program are tabulated.

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# TORSION BAR SPRINGING "CUSHIONS" THE LOAD ...adds years of service

## "Cable-Master" HYDRAULIC CABLE REEL TRAILER

Usual trailer bounce over bumpy roads has been eliminated from "Cable-Master" reel trailers by a unique torsion bar spring suspension system . . . for the load, the frame and the axles. Now, torsion bars . . . not the load . . . absorb shocks of the road. This exclusive jolt-cushioning feature is standard equipment that adds many maintenance-free years to both the trailer and tires.

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The front, full-swivel support wheel is power elevated to align the drawbar eye with the towing vehicle hook. The "Cable-Master" is available in capacities ranging from 8,000 to 12,000 lbs. for transporting reels up to 52″ wide and 96″ in diameter.

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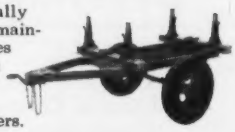

General Purpose Tool and Material Trailers:
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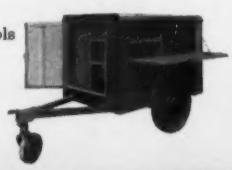

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# LETTERS

## Protest Upper Colorado Story

To the Editor:

Colorado River Basin Consumers Power, Inc, is pleased to see coverage of its transmission program in the March 28 issue of Electrical World (p 58).

The Colorado River Storage Project and its necessary electric components are subjects of considerable complexity. We have been impressed by the accuracy of coverage in Electrical World.

We were surprised by the map and caption you used in your article for the Consumers plan. We must object to both. First, the system you use is the 1975 or interim proposal in our program, while you use the 1980 or ultimate proposal for the investor group. It is entirely inaccurate to compare our 1975 proposal to an ultimate system and then say that it has less capacity in some portions.

Had you used the comparable time, it would have shown a second 230-kv line in Utah, a third 230-kv line from Poncha to Pueblo, and a second line at 230-kv from Glen Canyon to the New Mexico area, and only one 230-kv line into Arizona. This amply meets capacity requirements.

Second, our proposed system is grafted on the base map of the investor proposal and this considerably reduces the clarity of our proposal. If the Four Corners development occurs, it would fit our proposal as well as it does the company outline.

Third, even for 1975, our map contains a 115-kv line from Flaming Gorge to Sinclair, Wyo. Your map shows this link as going only half-way—a serious omission.

Fourth, the line from Flaming Gorge west should go to Provo rather than to Salt Lake City.

It may be that you do not have our complete study, although we supplied copies.

We would appreciate seeing our ultimate system map reproduced in Electrical World so that comparison of like systems and like times is possible. We are working to maximize our agreements and not real or potential disagreements. We are sure that you wish to make accurate reports. . . . The information in the March 28 issue is inaccurate and could lead to considerable misunderstanding.

Howard E. Scott, Secretary
Colorado River Basin Consumers Power, Inc
Denver 3, Colo.

▶We did compare the 1975 Consumers' plan, an interim stage, with the private companies' ultimate plan. It would have been more correct to compare ultimate vs ultimate. We don't agree, however, that the "times" would have been made comparable thereby, as the private companies' plan would be completed by 1970, the date the last CRSP generation is activated, while the Consumers' would not complete their scheme until 1980.

We believe the caption under the map and the method of superimposing the Consumers' proposal on the base map of the investor proposal to be fair. But we do apologize for the drafting errors which prevented the two lines from being shown correctly.

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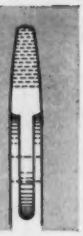

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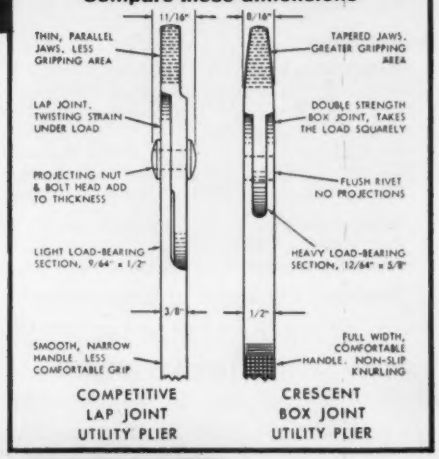
11/16"
8/16"
THIN, PARALLEL JAWS, LESS GRIPPING AREA
TAPERED JAWS, GREATER GRIPPING AREA
LAP JOINT, TWISTING STRAIN UNDER LOAD
DOUBLE STRENGTH BOX JOINT, TAKES THE LOAD SQUARELY
PROJECTING NUT & BOLT HEAD ADD TO THICKNESS
FLUSH RIVET NO PROJECTIONS
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3/8"
1/2"
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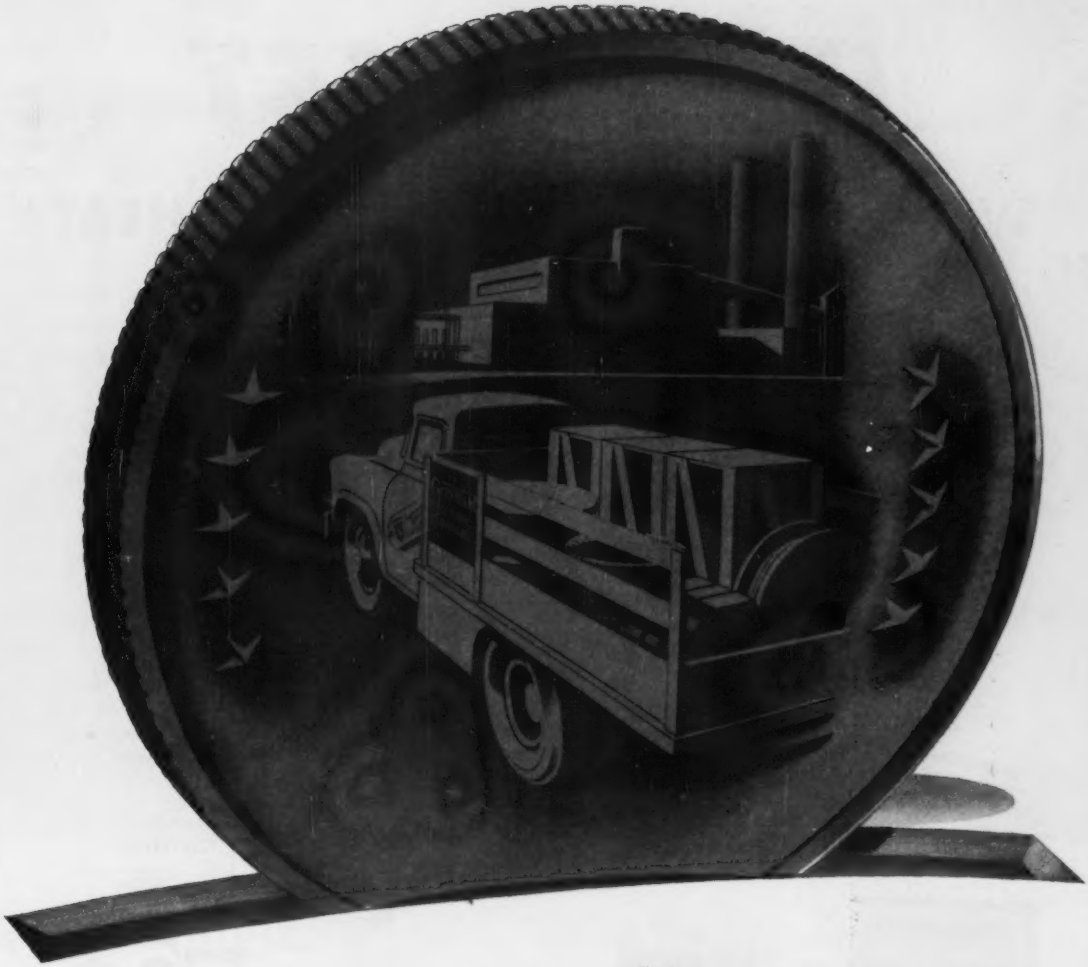

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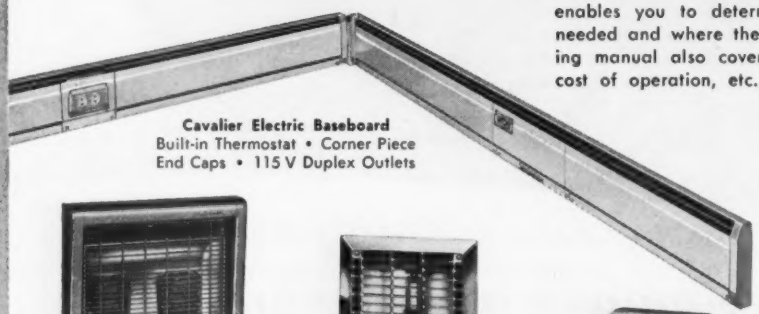

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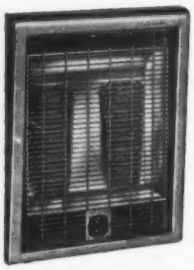
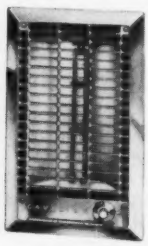


**Cavalier Wall Insert**
1 to 5 KW



**Cavalier Bathroom**
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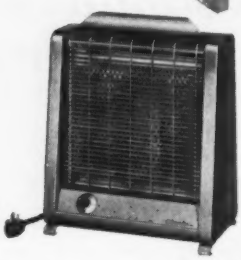
120 and 240 volt



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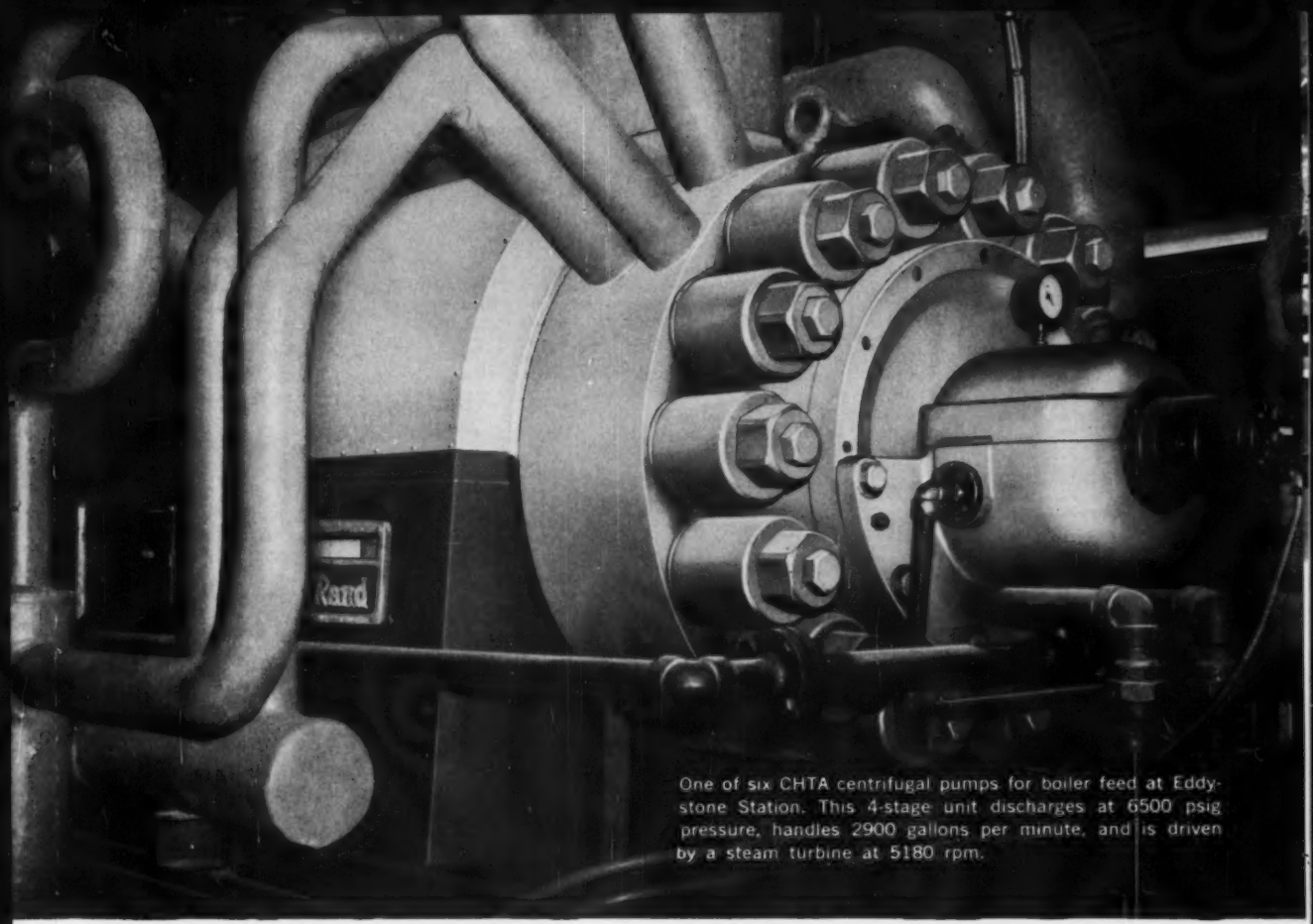


One of six CHTA centrifugal pumps for boiler feed at Eddystone Station. This 4-stage unit discharges at 6500 psig pressure, handles 2900 gallons per minute, and is driven by a steam turbine at 5180 rpm.

# World's highest-pressure boiler feeders now on the line at Eddystone

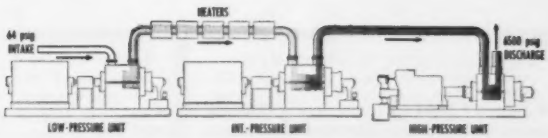
***Six Ingersoll-Rand centrifugal pumps boost boiler feedwater from 64 to 6500 psig at "world's most efficient power plant"***

Specifications for the 325,000-kw Unit No. 1 of Philadelphia Electric Co.'s Eddystone Station exceed those of any other power station ever built. Steam pressure is 5000 psi, steam temperature reaches 1200°F ultimately.

The Ingersoll-Rand centrifugal pumps handling the feedwater, which reaches a temperature of 574°F, are the highest-pressure boiler feeders ever built. Discharge is 6500 psig. There are two half-capacity systems, each consisting of low-pressure, intermediate-pressure and high-pressure pumps.

All of the I-R pumps are Class CHTA—single-suction, multi-stage diffusor-type units featuring symmetrical "double-case" construction and "unit-type" rotor assembly for dependable performance and minimum maintenance. The shaft, impellers and stationary channel rings are assembled as a compact, completely self-contained inner-casing unit.

For more information on the CHTA, contact your I-R representative. Or write for bulletin 7211-A.



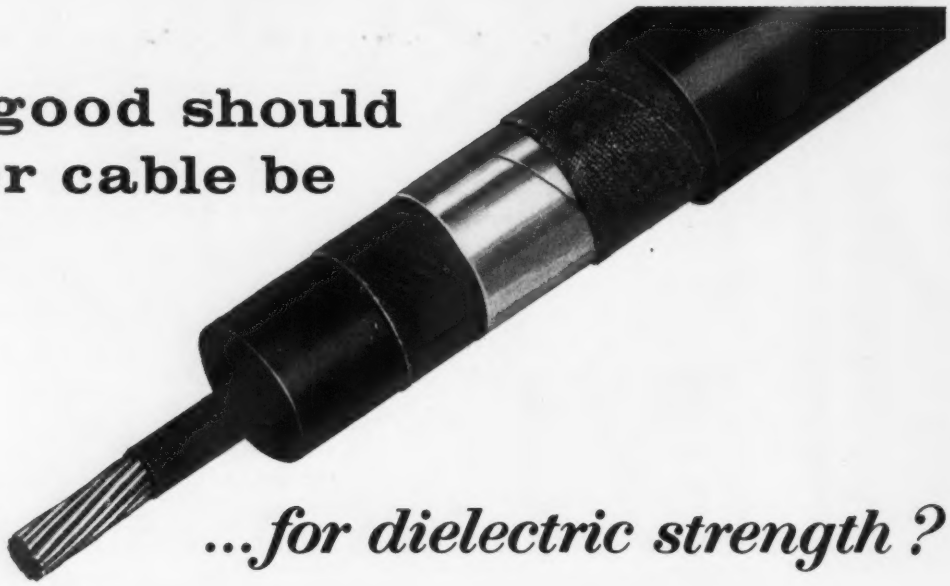

Six I-R CHTA pumps are operating at Eddystone in two half-capacity systems, each consisting of three pumps in series as shown above.

**Ingersoll-Rand**

139A10

11 Broadway, New York 4, N. Y.

# how good should power cable be



## ...*for dielectric strength?*

At CIRCLE, the point is not how well specifications are met—but rather *how far they can be exceeded!* Take, for example, the well-known "double voltage test" as required by IPCEA-NEMA.

### IPCEA-NEMA Performance Requirements

"6.5.3 After the sample has been immersed for at least one hour, it shall withstand for 5 minutes a test voltage which is twice the test voltage given in Table 12."

"6.5.4 . . . starting with the voltage at which the test described in 6.5.3 was made, the voltage shall be raised in steps of approximately 20 per cent of the immediately preceding voltage until failure occurs, the voltage to be kept constant at each step for 5 mintues."

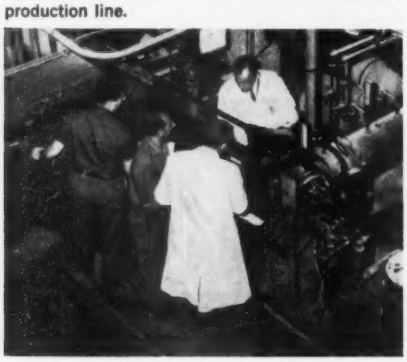
### "Circlesheath® Type RR Power Cable Performance"

The following table describes the performance of three samples of Circle butyl-insulated Type RR power cable.

| CABLE SIZE | RATED VOLTAGE | DOUBLE AC TEST VOLTAGE | CIRCLE B'KDN VOLTAGE | MAXIMUM STRESS IN VOLTS PER MIL |
|---|---|---|---|---|
| 2 AWG | 5KV | 28KV | 48.3KV | 454 |
| 1/0 AWG | 5KV | 28KV | 40.3KV | 356 |
| 500 MCM | 5KV | 31KV | 44.6KV | 307 |

A Circle power cable, subjected *for over two years* to a 250% overload of rated voltage in a *test still in process*, continues to meet all specified requirements.

A frequent sight at Circle is the checking of extruder operation by laboratory technicians. They are concerned with seeing that the quality they build into a cable in the lab is realized on the production line.



Turning out high-reliability power cable requires expert knowledge of compounds, absolute quality control—and men who *know enough* to produce the very best. Next time you specify power cable, ask for Circle—there's no finer made.

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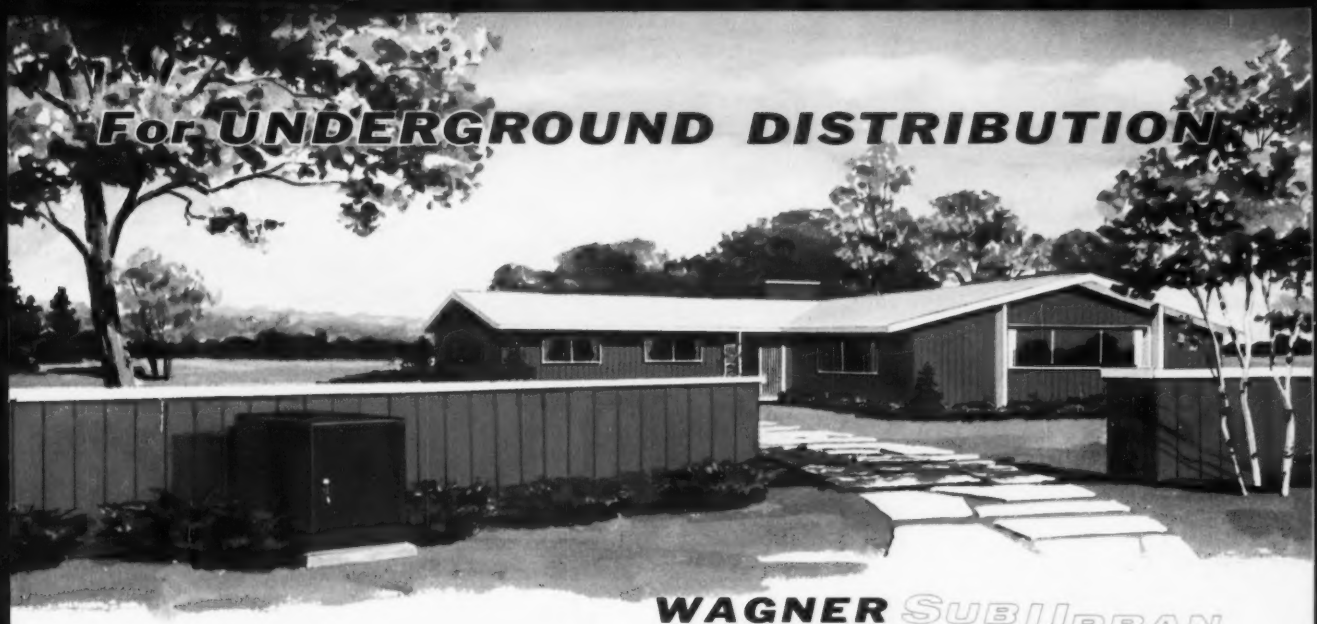
RUBBER COVERED WIRE & CABLE • VARNISHED CAMBRIC CABLE •
PLASTIC INSULATED CABLE • NEOPRENE SHEATHED CABLE • CIRTUBE® EMT




# WAGNER SUB URBAN TRANSFORMERS

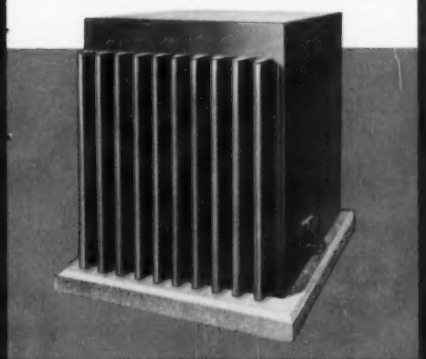
## are safe . . . well-ventilated . . . adaptable to future load growth

Wagner Sub-Urban Pad Mounted Transformers are designed to be used wherever underground distribution is necessary or desirable. Their compact size and low profile make them ideal for use in residential areas—plantings of low shrubbery will hide them. They are safe to use—underground systems protect the public from exposed hot lines, and the tamper-proof enclosure can be padlocked. A protective door over the primary compartment permits working on the secondary without danger from high voltage. Well-ventilated, they can be loaded to capacity. When load growth makes it necessary, larger transformers can be quickly and easily installed to replace the original transformer units.

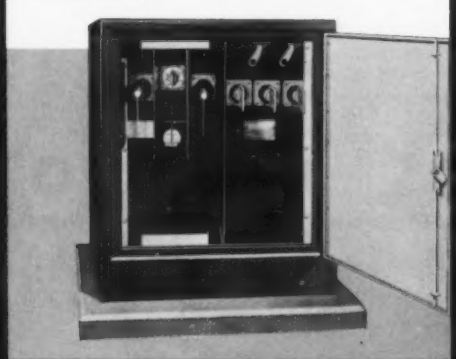
Get the whole story of Wagner Sub-Urban Transformers. Consult your nearby Wagner Sales Engineer, or write for Bulletin TU-148.

**Wagner Electric Corporation**
6400 PLYMOUTH AVENUE, ST. LOUIS 33, MO.

**BUILT TO LAST**—Tank is of heavy gauge sheet steel, with welded-on cover. Smoothly shaped radiators are welded to tank along their entire length. Complete special asphalt-type undercoating gives lasting protection against rust and corrosion.



**SINGLE-PHASE**—Here is the terminal cabinet of a 100 Kva single-phase transformer. Barrier plates are provided between the high voltage bushings and between the high and low voltage compartments. Single-phase units are available in ratings from 25 through 167 Kva.



**THREE-PHASE**—Terminal cabinet of a 225 Kva three-phase Sub-Urban Transformer. High voltage tap changer is at the left side of the nameplate. Three-phase pad units are available in ratings from 75 through 500 Kva.

**WAGNER DISTRIBUTION TRANSFORMERS**
***. . . the choice of leaders in the electric utility industry!***

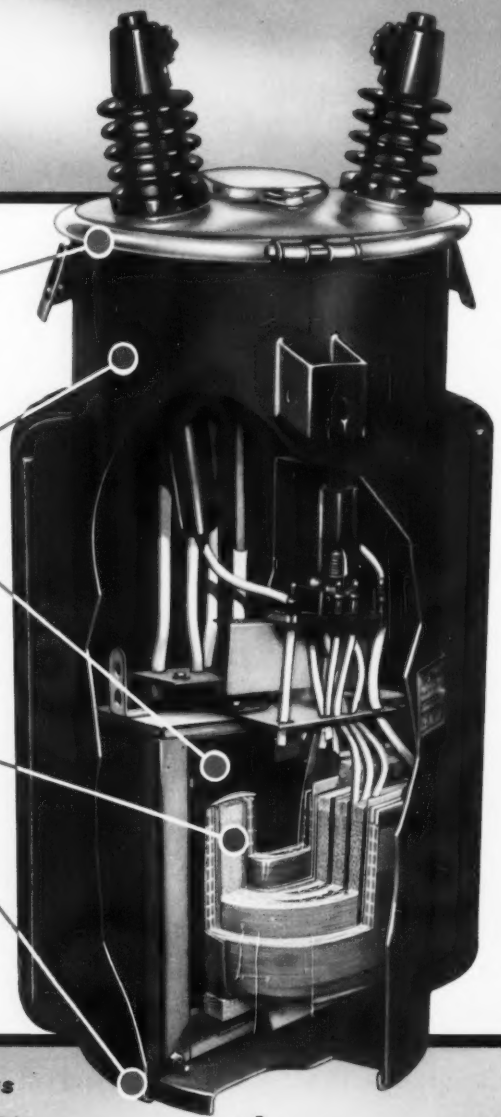
# For OVERHEAD Distribution...

## WAGNER POLE-TYPE TRANSFORMERS

### give longer life... greater efficiency

Wagner pole-type single-phase transformers are designed to meet all electrical requirements of modern overhead distribution systems: high efficiency, low exciting current, low impedance, high short circuit and overload capability. In addition, they offer mechanical features such as smaller size... safety-keyed bushings, and a long-lasting tank finish that give you easy installation, safe operation, long service life—extra value for your transformer dollar.

They are available in ratings from 5 to 250 Kva, 15 KV and below, from factory, branch, and distributor stocks. Consult your nearby Wagner Sales Engineer about your transformer requirements, or write us.



**PLASTIC-COATED COVER**

This porcelain-like coating gives improved corrosion resistance to tank covers, protects from line to ground, insulates small animals from the grounded cover to prevent outages. Applied to the covers, clamping ring and cover bolts, it is available without extra cost on all Transformers with cover mounted bushings.

**LONG-LIFE TANK FINISH**

A new formula anti-corrosive paint, carefully applied and thoroughly cured, provides a "Sure Seal" finish that withstands all temperature changes—is much longer lasting in corrosive atmospheres.

**LOW LOSS CORE**

Made of highest quality cold-rolled steel, wound to provide a low reluctance path for the magnetic lines of force. Keeps losses and exciting current low.

**COIL,** carefully wound of pure copper wire or strip, has new lower impedance to improve voltage regulation.

**BONDED INSULATION**

Layer, channel and barrier insulation is coated with a thermo-setting material that bonds the coil structure into a strong, electrically efficient unit with high short circuit capability.

**ROLLED-UNDER BASES**

This new base design provides extra strength... better moisture drainage. Serves as an additional safeguard against leakage of oil from the tank. It lessens the chance for finish damage due to scraping.

*BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES*

## Wagner Electric Corporation

6400 PLYMOUTH AVENUE, ST. LOUIS 33, MO.

WT60-11

# The Electrical Week

**LATE NEWS ▶** **Washington Wire** . . . Senate Interior Committee probably won't hold any more hearings this year on a bill calling for a Federal Resources Council and Joint Committee on Resources. But watch for an attempt to vote the measure out of committee anyway . . . U. S. Court of Claims approves power sales agreement between Citizens Utilities Co and Bureau of Reclamation.

**Around the States** . . . N. Y. State Power Authority Chairman Robert Moses pushes again for role in state's A-power development . . . Ohio PUC promises Toledo it will probe Toledo Ed's request for a 15.5% rate hike . . . Meanwhile, Pennsylvania PUC plans state-wide survey of utilities' earnings . . . Dover, Del., City Commission OK's $9 million bond sale. Money will be used to build municipal power plant to handle all of city's requirement. Dover presently buys two-thirds its power from Delaware P&L.

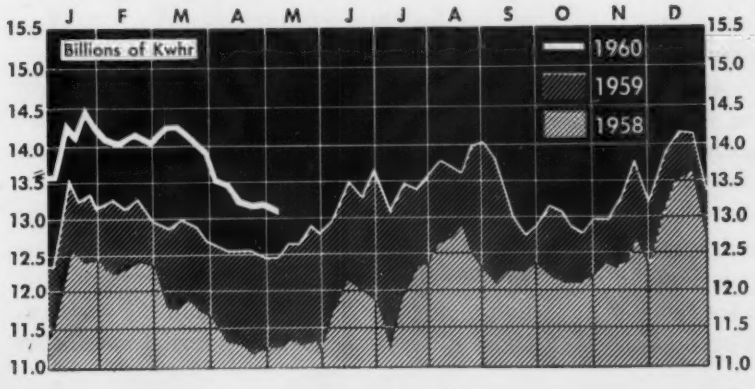
**Bonneville offers 300 Mw of power to Northwest industrial customers.**

**GE will supply computers** to control Southern California Edison's two 310-Mw t-g units at Alamitos Station. Computers will be similar to those used at SoCalEd's Huntington Beach Station.

**Russians say they've completed blueprints for 1,000-Mw turbine.** U. S. powermen are skeptical in view of the much smaller units (150-200-Mw) now in use or being built in the USSR.

**Management changes** . . . Rodman McClanahan becomes president of Middle West Service Co, succeeding J. Samual Hartt, who becomes board chairman . . . Dewey J. DeBoer elected president of American Public Power Assn, succeeding Paul Raver, Seattle City Light.

## WEEKLY POWER OUTPUT—UP 3.8% (Week ending May 7), Kwhr 13,139,000,000




Per Cent Change From Previous Year

| | Apr. 23 | Apr. 30 | May 7 |
|---|---|---|---|
| Total U. S. | + 5.4 | + 6.0 | + 3.8 |
| New Eng. | + 6.6 | + 4.7 | + 7.5 |
| Mid. Atlan. | + 4.6 | + 6.2 | + 6.3 |
| Cent. Ind. | + 3.2 | + 3.9 | + 2.1 |
| West. Cent. | + 3.4 | + 6.5 | + 3.9 |
| Southeast | + 4.2 | + 6.4 | + 3.8 |
| South Cent. | + 7.1 | + 5.7 | − 2.0 |
| Rocky Mount. | + 9.0 | +11.4 | + 8.0 |
| Pacific | | | |
| NW | +15.2 | + 9.5 | + 6.5 |
| SW | + 7.0 | + 6.8 | + 5.0 |

Seasonally Adjusted Index 267.0

Week Ago 269.2 Year Ago 253.9

Source: Edison Electric Institute

# Preview of This Issue

**EVENTS ▶** **Senate Interior Committee asks delay on BPA-California intertie** until it can come to a decision in the matter **(p 56)** . . . Rural Electrification Administration celebrates its 25th birthday **(p 57)** . . . Utilities suffer heavy damage in Oklahoma tornadoes **(p 58)** . . . Reaction to sale of American & Foreign Power's Mexican properties is mixed **(p 59)** . . . AEC decision is expected on proposed 50-Mw A-plant to be built jointly by Los Angeles and Pasadena **(p 59)** . . . A rise in TVA rates as it prepares to market first bond issue **(p 60)**?

**SPECIAL REPORT ▶ FIFTH NUCLEAR POWER REPORT** **AEC introduced a 10-year program to make A-power competitive** this year with conventional power plants by 1968. Electrical World's 5th Nuclear Power Report **(p 63)** presents the highlights of this program and the conclusions of the study on which it was based **(p 64)**. It also offers a summary of the status of present civilian reactor power projects, their relationship to each other and to the civilian power reactor program **(p 67)**. The report also features a tabulation of the vital statistics of present A-power prototype plants and experimental reactors **(p 76)**, along with a map showing their location **(p 82)**.

**ENGINEERING ▶** **The space under a generating unit can be increased** by placing the unit's center line at floor level. Wisconsin Electric Power did this

# Politics and Public Power

### A COMING BATTLE IN THE SENATE

President Eisenhower's recent two appointments to the Federal Power Commission—Thomas J. Donegan and Paul A. Sweeney—have raised a lot of ire and eyebrows in Washington, and it's a pretty good bet that there will be a battle in the Senate over their confirmation in this election year . . . if the Senate considers the matter at all.

In the first place, the Administration's handling of l'affaire Connole angered a number of important members of the Congress who have for some time been critical of the way business has been done by the regulatory commissions.

Secondly, the President's refusal to reappoint Connole to FPC on the basis that he "could get a better man" has forced his critics to ask, "Better than what?" And this may lead to a public comparison of Connole and Donegan during the confirmation procedures, with possible injustices to both.

Finally—and this cannot be linked to Donegan and Sweeney solely—there are some prominent, politically perceptive people who think they see a pattern in the recent appointments to the regulatory commissions, a pattern that could have political significance when one remembers that Eisenhower will vacate the White House in less than a year.

It is this last point—considered in the light of Mr. Eisenhower's announced favor of Vice President Richard Nixon as his heir apparent—that is most interesting.

A noted national columnist points out that all of the recent commissioners, including the FPC'ers, are career government servants, that none of them has done anything particularly illustrious or controversial, and that

with its No. 5 unit at Oak Creek Station, thus making more room for piping, cross-unders, and other equipment **(p 61).**

**PROCUREMENT & PRODUCTS** ▶ **Soft prices on "many items of electrical equipment"** were reported by National Assn of Purchasing Agents . . . Worthington Corp cuts boiler feed pump prices about 10% **(p 96)** . . . International Business Machines Corp announces (1) "Off-the-shelf" computer programs for utilities; (2) a Stretch computer, claimed to be the fastest, most versatile computer in the world; and (3) The "Tractor," a computer magnetic tape system **(p 101).**

**ELECTRICAL BUSINESS OUTLOOK** ▶ **Business expects to lay out $37.9 billion for new plants** and equipment this year. The goal of this unprecedented amount is efficiency; two-thirds of the money will go for modernization. How will this spending affect electric utilities? Read our report on McGraw-Hill's 13th annual survey of capital spending plans **(p 127).**

**SELLING** ▶ **New lighting—94 kw of it—suits to a tee the golfers in Springfield,** Mo., helps them sharpen their game at night **(p 135).**

**NEXT WEEK** ▶ **Seattle City light pleases real estate men with beautiful substations.**

they have all, at one time or another, worked with or for Richard Nixon or Attorney General William Rogers.

Now, what sort of political significance might be read into these circumstances?

Here are a few conjectures:

• That it is Vice President Nixon, rather than President Eisenhower, who is calling the shots on the regulatory commission appointments. Or, if one prefers a milder statement of the same thesis, that the President is relying heavily on Mr. Nixon's advice.

• That Attorney General Rogers may well be the Vice President's choice—to date, kept secret—for a running mate in November.

There are two developments centered around Rogers that tend to back up this guess. Both have to be considered with respect to Mr. Nixon's avowed intention of removing the "Old Guard-Big Business" labels from the Republican Party.

The first is Mr. Rogers' strong stand on civil rights. The second is his reputation—built to a large extent during his tenure as attorney general—as a militant anti-truster.

The kind of political hay the Democrats can make of these developments should be obvious. For example, it should surprise no one if the charge is made in the Senate that Nixon is "stacking" the commissions.

Perhaps the Senate will not act on the FPC appointments at all, allowing Donegan and Sweeney to assume their offices on an interim basis. Then, if a Democrat is elected President in November, his party will have a chance to control the commission by replacing them and later, in 1961, replacing Republican Arthur Kline with a Democrat.

These are all interesting possibilities in an election year. Their threat might be lessened if the President would reconsider Connole.

# Nuclear Notes

**Los Angeles Dept of Water and Power,** together with its neighbor Pasadena, submitted one offer and Western Farmers Co-op of Anadarko, Okla., another to build a 50-Mw generating plant to take its steam from an AEC boiling water reactor. GE, Combustion Engineering, Allis-Chalmers and Westinghouse, each in combination with a constructor, are bidding on the improved cycle BWR. Western Farmers is a generation and transmission co-op with 78,400 kw generating capacity and supplies 26 western Oklahoma counties.

**Proposals from municipalities and co-ops** to operate a small AEC-owned nuclear plant have been weeded to two submitted by Jamestown, N. Y., and Dairyland Power Co-op of Wis. Both, however, must find better sites than those proposed, which the AEC deemed "not fully satisfactory." Dropped were bids from Detroit, Ft. Pierce, Fla., and Miamisburg, Ohio.

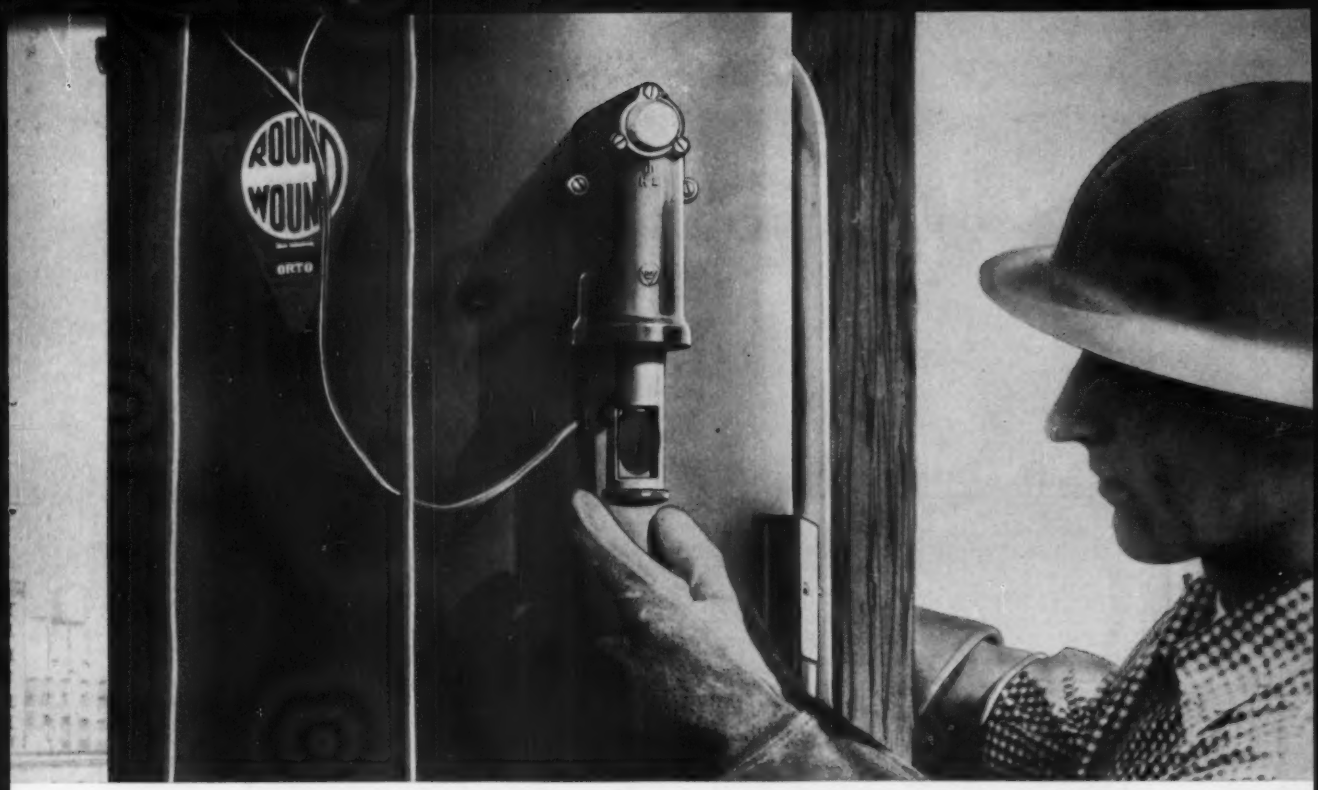
**Yankee Atomic Electric's license to operate** its 120-Mw plant at Rowe, Mass., will be considered by the AEC at a May 25 hearing.

**Mass production of water reactors is claimed by Pravda** in a recent article about Lenin prizes awarded to developers of these units. But only 12 have been completed. The article indicated that these are training reactors with capacities somewhat larger than 100 kwt. Prime aim of this building program seems to be propaganda: they are being offered to other lands.

**Dresden produced nearly 25 million kwhr** before shutting down on schedule May 1 to be checked over. There seems to be no obstacle to taking the big plant to full power.

**Economical nuclear power production** by plants completed in 1968 or, in some cases, even sooner was predicted by Donald H. Stewart, AEC's assistant director for civilian reactor development. Speaking before the Columbia Basin Inter-Agency Committee, Stewart declared that sound engineering practice gradually will develop plants with greater simplicity and cheaper components, cores with higher power densities and efficiencies, cheaper fuels, the ability to exploit higher temperatures, and a keener understanding of the factors critical to safe operation.

**Many Americans suffer from radiation jitters,** doctors and physicists brought out at the conference on Radioactivity in Man at Vanderbilt University. While they pointed out that radiation is to be respected, they denied there is severe danger to today's citizen from x-ray treatment, low level radioactivity and nuclear industry. Dr Marshall Brucer, head of Oak Ridge Institute of Nuclear Studies medical division, said, "Overemphasis on radiation hazard is more dangerous than underemphasis of radiation safety." Dr Brucer said that the nuclear industry is one of the safest. "The people who handle radioactive materials aren't the ones who do the most worrying about it."



**WHEN PROLONGED OVERLOAD** overheats the transformer windings, top oil temperature rises; tank wall gets hotter; and the L-M Thermal Overload Indicator drops its red signal light or luminous yellow tube to indicate the overload. No interruption of service; no costly periodic load checks. Fits any make of conventional transformer up to 100 kva.

# Utilize Full Transformer Overload Capacity With L-M Thermal Overload Indicator

## Cuts costs of load checks; helps maintain continuity. Alnico magnetic mounting bracket makes installation easy on *all* makes of conventional transformers. Choice of red signal light or luminous yellow tube signal.

Utility companies have been buying L-M's Type D Thermal Overload Indicator in large quantities for a number of reasons. The unit is simple; it is easy to install; and the cost is less than a $10 bill.

The indicator eliminates costly periodic load checks, by providing a *continuous* load check instead. It helps prevent transformer burnouts by giving ample warning. In addition, it avoids service interruptions because it doesn't cut off the transformer load; it simply *indicates* the existence of an overload.

L-M's indicator, compensated for ambient temperatures, measures tank-wall temperature, which in turn reflects top oil and hot-spot temperatures. It indicates a prolonged overload with a red light that drops down and turns on, or with a drop-down luminous yellow tube.

The small cost provides a most favorable return in both savings and service continuity. Ask the L-M Field Engineer for Bulletin 57105 or a sample. Or write Line Material Industries, Milwaukee 1, Wisconsin.

**ALNICO PERMANENT MAGNET** holds the L-M overload indicator firmly to the tank wall.

**LINE MATERIAL® Industries**

McGRAW-EDISON COMPANY

*Protective Equipment*

McGRAW EDISON

391-R

DISTRIBUTION TRANSFORMERS • RECLOSERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS • LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT
PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS • OUTDOOR LIGHTING • LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE & CONDUIT

# LOW OVERALL COST DEMAND MEASUREMENT

## DOES IT LOGICALLY

The Duncan Thermal Demand Meter follows the same general heat-time curve that determines system capacity.

## UNNECESSARY PARTS ELIMINATED

Long, reliable service is assured by a design using one moving part — moving only when the load changes.

## NO CALIBRATION PROBLEM

Only one adjustment for up-scale point. Adjustments of the watthour meter do not affect the thermal accuracy.

## CAPACITY TO MEET YOUR NEEDS

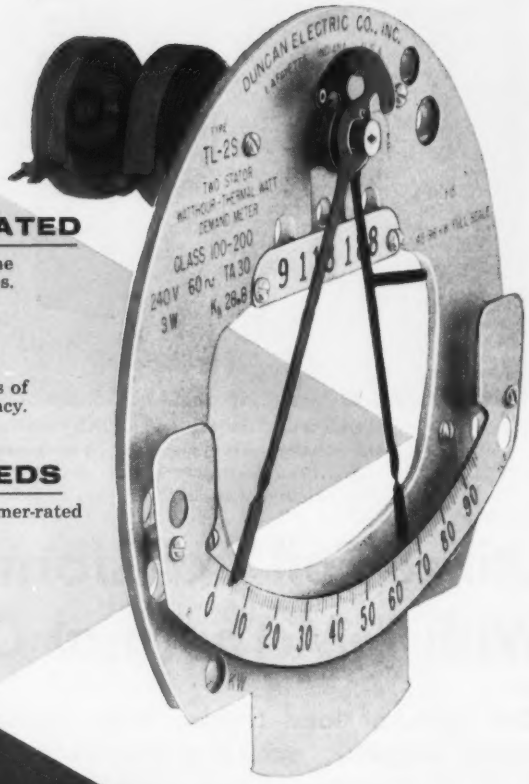
Available in a full line of self-contained and transformer-rated meters. Maximum range to 200 amperes.

## ACCURACY MATCHES LOAD

The Thermal Demand Meter does not split peaks. It measures actual demand.

## NO LARGE INVENTORY

Dual range scale combinations available to cover most rate structures with a minimum of meters.


DUNCAN ELECTRIC CO., INC.
TL-2S
TWO STATOR WATTHOUR-THERMAL WATT DEMAND METER
CLASS 100-200
240 V 60 ~ TA 30
3 W
0 10 20 30 40 50 60 70 80 90

## THERMAL METERS

"Thinking Ahead ... Moving Ahead ... to stay Ahead of Demand"

WATTHOUR METERS • MOUNTING DEVICES • DEMAND METERS

## How C. H. Wheeler condenser design provides optimum deaeration and REDUCES STATION MAINTENANCE

**An informative advertisement from one of the nation's most experienced condenser manufacturers**

The problem of power plant steam system maintenance involves many things including cleaning the water and steam sides of condenser tubes, tube damage caused by impact of water in exhaust steam, tube abrasion resulting from sand or grit in the circulating water, tube plugging resulting from foreign matter in the circulating water, and deposits in the boiler.

One of the most important ways to reduce station maintenance requirements is to improve deaeration. Excess air in condensate results in corrosive oxide deposits in the boiler which decrease its efficiency. During 56 years of condenser design and manufacturing, C.H. Wheeler has developed a number of ways to produce deaerated condensate *in the condenser*. In special designs, they maintain oxygen content of less than 0.01 cc. per liter. Oxygen levels of far less than 0.01 per liter are often achieved in C.H. Wheeler Condensers, depending upon the amount of air leakage of the system and the amount of contaminated returns.

Basic causes of oxygen and other non-condensable vapors in condensate are system leaks, heater returns and make-up water.

Full deaeration of make-up water requires bringing it up to the temperature of the steam, so that the condensate is 100% saturated with water vapor and all gases have been driven from solution. However, to be sure that no gases are mechanically

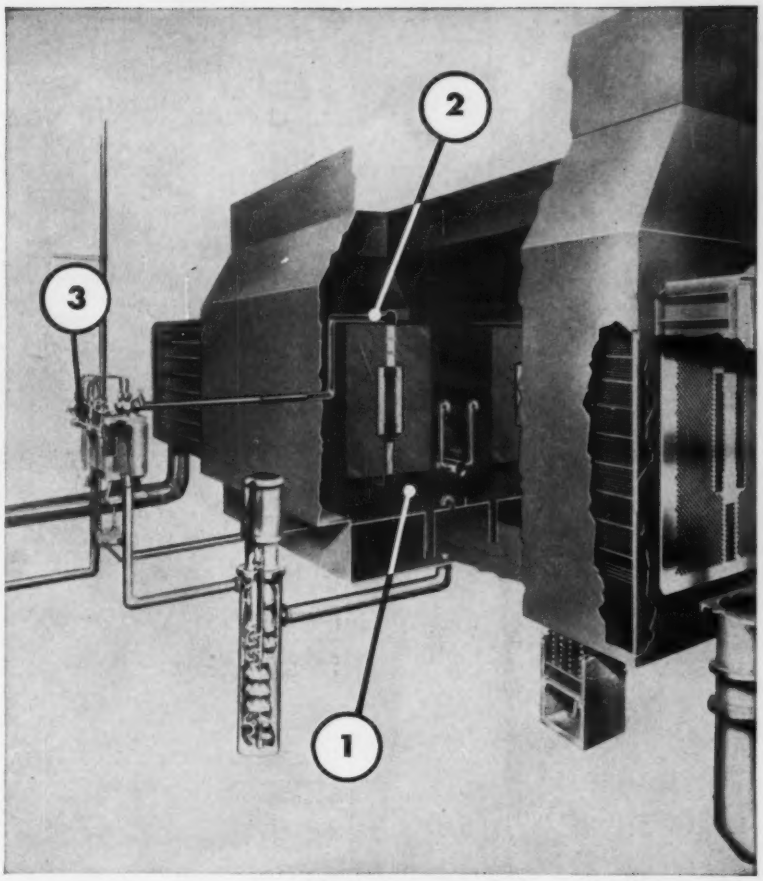



*Figure 2: Cutaway drawing of portion of C.H. Wheeler Dual Bank, Divided Water Box Condenser.*

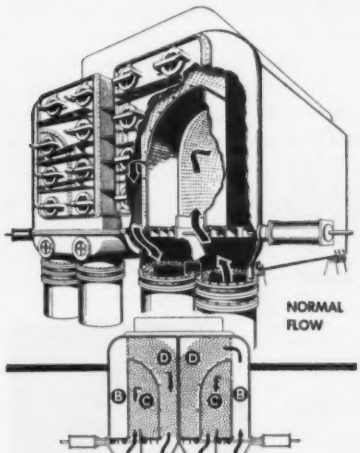



*Figure 1: Schematic diagrams of C.H. Wheeler Reverse Flow.*

entrained in the droplets of water, the water must be agitated thoroughly to permit release of any remaining air bubbles.

In C.H. Wheeler Condensers, normal make-up water is heated to steam temperature and agitated to release non-condensables by spraying it over the top of the tube banks at both ends of the tubes, and out of the path of high-velocity steam from the turbine exhaust. Steel bars above the tubes protect them from water impingement damage. Heater drips are sprayed in the steam lanes to permit flashing and release of entrained gases.

Condensate is cascaded over deaerating bars (1, in Figure 2) in the presence of a moving blanket of steam, to provide proper agitation and reheating before it is drained into the hotwell. The Tubejet® Air Ejector (3) draws off non-condensable gases through the air-vapor suction line (2), and discharges them to the atmosphere. Central location of the air cooler section reduces depth of steam penetration and resistance to steam passage, achieving a new low in condenser pressure loss.

### Another Big Problem—Tube Cleaning

If your water supply is polluted, condenser tube deposits may become troublesome. There are several ways to correct this situation: Shooting small slugs through the tubes with high-pressure water, using acid and chlorinating the circulating water, among other methods.

One method particularly successful in removing algae, and foreign matter such as twigs, leaves and scale, is Reverse Flow (see Figure 1). Developed by C.H. Wheeler, it makes possible the flushing of tubes and sheets without shutting down the condenser.

*Here's how Reverse Flow works:* Normal operation is shown on the left. Water enters through inlet A with right inside port open, flows through tube bank C to the rear of the condenser. It returns through tube bank D to the front of the condenser, and then it discharges at E.

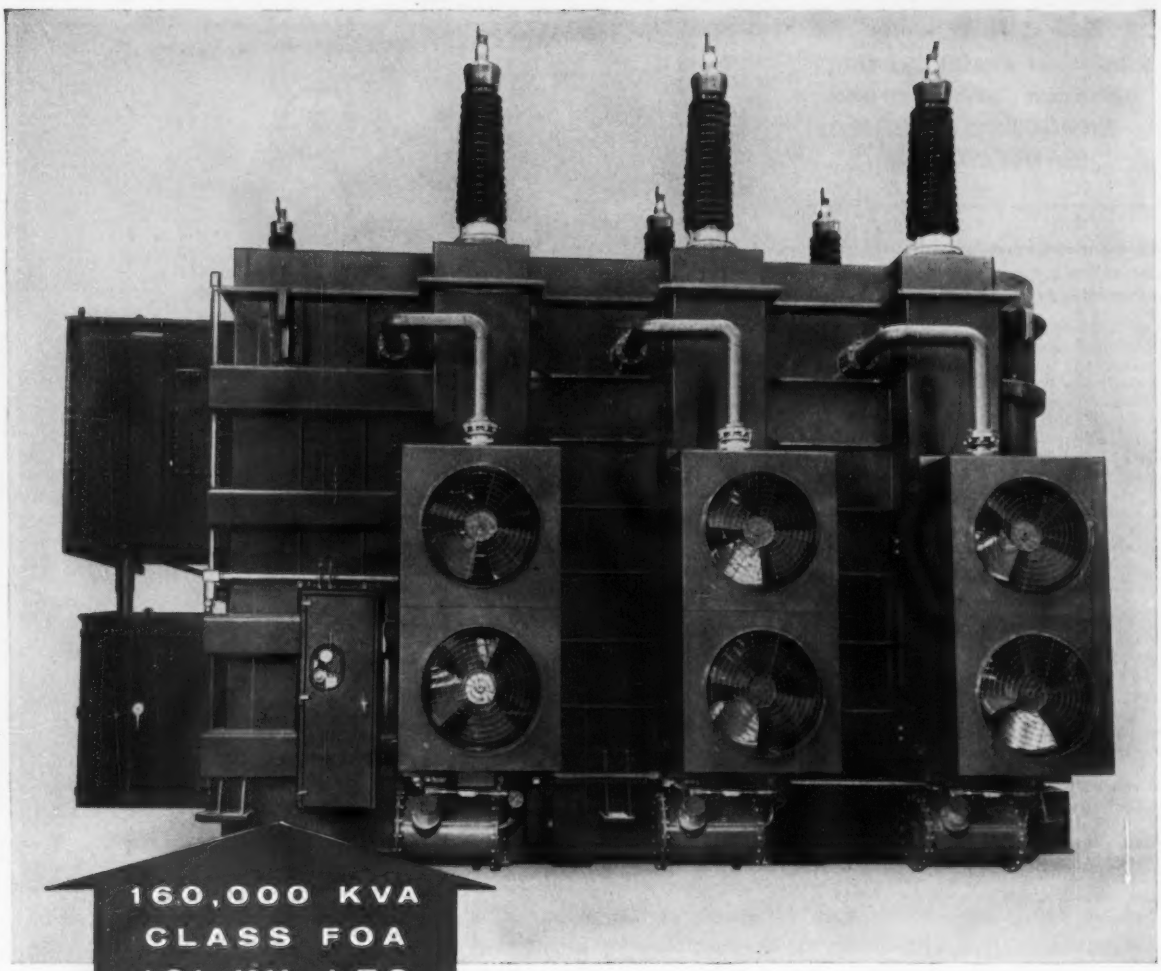
The right side of the diagram shows Reverse Flow in operation in a C.H. Wheeler Dual Bank, Divided Water Box Condenser. Water enters through A with outside port open, flows up through channel B and through tube bank D to rear of condenser, returns through tube bank C to front of condenser and discharges at E. Reversing can be accomplished during full load operation and full flow of circulating water, without additional pressure loss. Sluice gates for each half of the condenser move on a common stem. Each half can be back-flushed independently; or both halves can be back-flushed simultaneously with one or two circulating pumps operating.

# C. H. WHEELER MFG. CO.

**19th and Lehigh Avenue • Philadelphia 32, Pennsylvania**

*Whenever you see the name C.H. Wheeler on a product, you know it's a quality product.*

Steam Condensers • Steam Jet Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Components




Moloney combination transformer and auto transformer now in operation for a large midwestern utility. Voltage ratings are: HV 161 KV Grd. Y @ 160 MVA, LV 115 KV Grd. Y @ 118 MVA, TV 13.8 KV delta @ 42 MVA. HV and LV windings have a one step reduction in BIL. No-load taps are provided in the HV and TV windings. LTC equipment provides + or − 10% regulation at TV terminals.

This unit operates in parallel with four other transformers and meets the following three conditions of loading:

| | | |
|---|---|---|
| HV 160 MVA | LV 118 MVA | TV 42 MVA |
| HV 118 MVA | LV 118 MVA | TV Idle |
| HV 42 MVA | LV Idle | TV 42 MVA |

The many conditions met in designing this unit are evidence of Moloney's ability to provide power transformers for every application. Specify Moloney . . . All Along The Line.

MESO-11

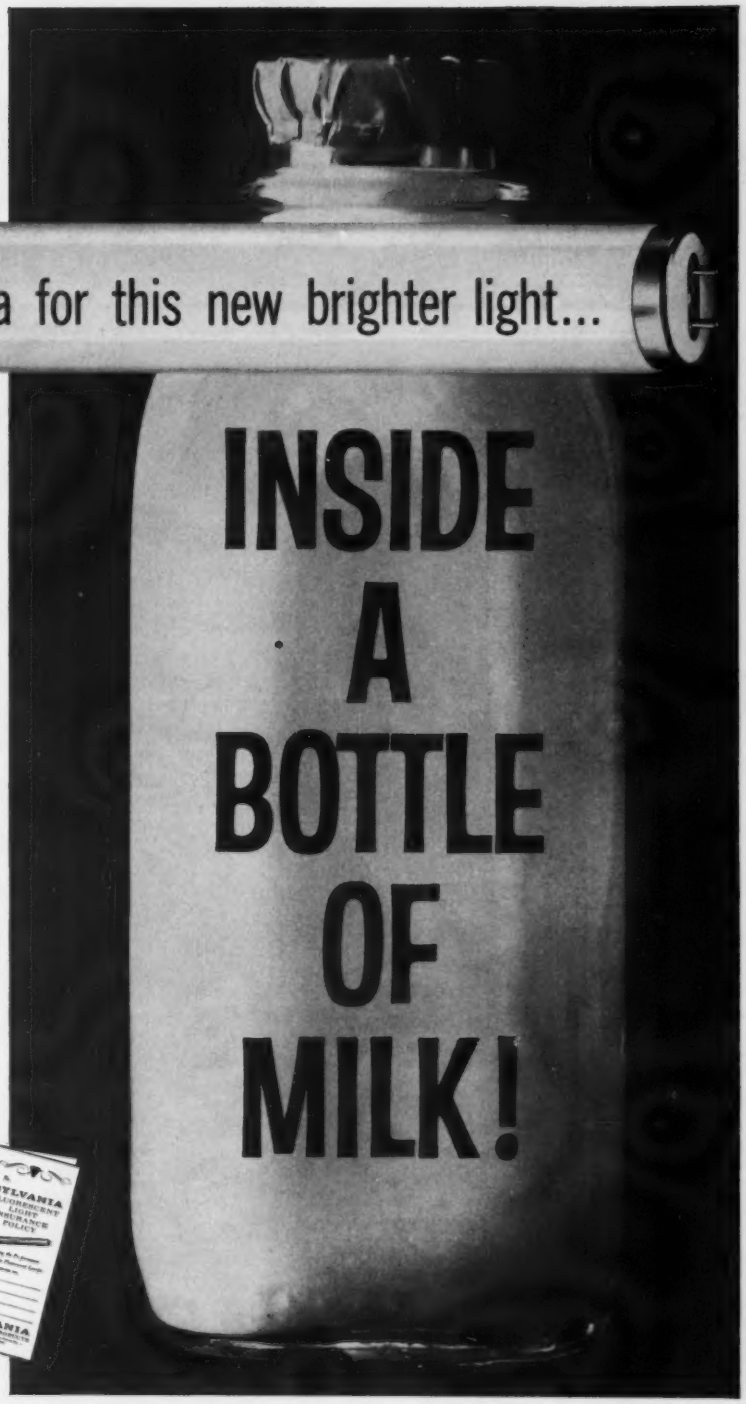
*Since 1896... MORE POWER TO YOU*

**MOLONEY ELECTRIC COMPANY**

*Transformers for Utilities, Industry and Electronic Applications*

MOLONEY ELECTRIC

FACTORIES: ST. LOUIS 20, MO. • TORONTO, ONT., CANADA • SALES OFFICES IN ALL PRINCIPAL CITIES



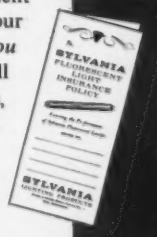

Ever notice homogenized milk—its clean uniformity? Sylvania engineers have taken the same principle and applied it to *light.* They have *homogenized* the phosphors in fluorescent tubes. And the result? Greater, more uniform brightness!

This is one reason why *Sylvania fluorescents deliver up to 14% more light than other brands.* Consistently! In *maintained* brightness alone every 100 Sylvania tubes give you as much light as 108 ordinary fluorescents! Hour after hour after hour!

Sylvania fluorescents last longer, too. Most fluorescents have soldered tube-to-base points. Sylvania *welds* them. Corrosion problems are eliminated, replacements reduced, maintenance costs cut!

**Insured to perform better!** And only Sylvania fluorescents are backed by the *exclusive* Sylvania "Light Insurance Policy." Your greatest assurance of lower TCL (Total Cost of Lighting), which means cost of lamp plus power plus maintenance. Sylvania fluorescents are *guaranteed* to perform better, in your opinion, than the brand you are using—or your money back!

These are just a few examples of consistent Sylvania leadership in lighting. Let your Sylvania representative show how *you* can get more light for less money. Call him, or write us: Sylvania Lighting Products, a Division of Sylvania Electric Products Inc., Dept. 64, 60 Boston Street, Salem, Mass. In Canada: Sylvania Electric (Canada) Ltd., P. O. Box 1190, Station "O," Montreal 9.




# SYLVANIA

*Subsidiary of* **GENERAL TELEPHONE & ELECTRONICS**

# another major

"PLAY BALL" will echo through Candlestick Park, new home of the San Francisco Giants, during the 1960 National League baseball season. Hatfield wire and cable has been used extensively for field lighting and other electrical services, in this newest, most modern ball park.

THE MOST UP-TO-DATE FACILITIES for the production of rubber insulated wire and cable are now in production at Linden, New Jersey. Hatfield's new automated Linden complex also includes a new copper rod mill. Adding the plastic insulated wire and cable facilities at Hillside, N. J., Hatfield now has more than 600,000 square feet of production space in operation.

*General Contractor,* CHAS. L. HARNEY
*Construction Management,* MACDONALD, YOUNG and NELSON, INC.
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It takes "major league" wire and cable products to meet all kinds of requirements and come through with a winning performance every time. Because Hatfield's record ranks right up there with the all-time, all-weather, long-lasting greats in the wire and cable field, it is understandable why Hatfield products were specified for Candlestick Park — the new home of the San Francisco Giants. Few can match Hatfield's performance record, because Hatfield consistently "touches all bases". First . . . prompt, efficient service; Second . . . rapid delivery; Third . . . careful adherence to specifications; scoring every time . . . a complete line of plastic and rubber-covered wire and cable for construction, utilities and general industry. If you want the best, put Hatfield on your team.

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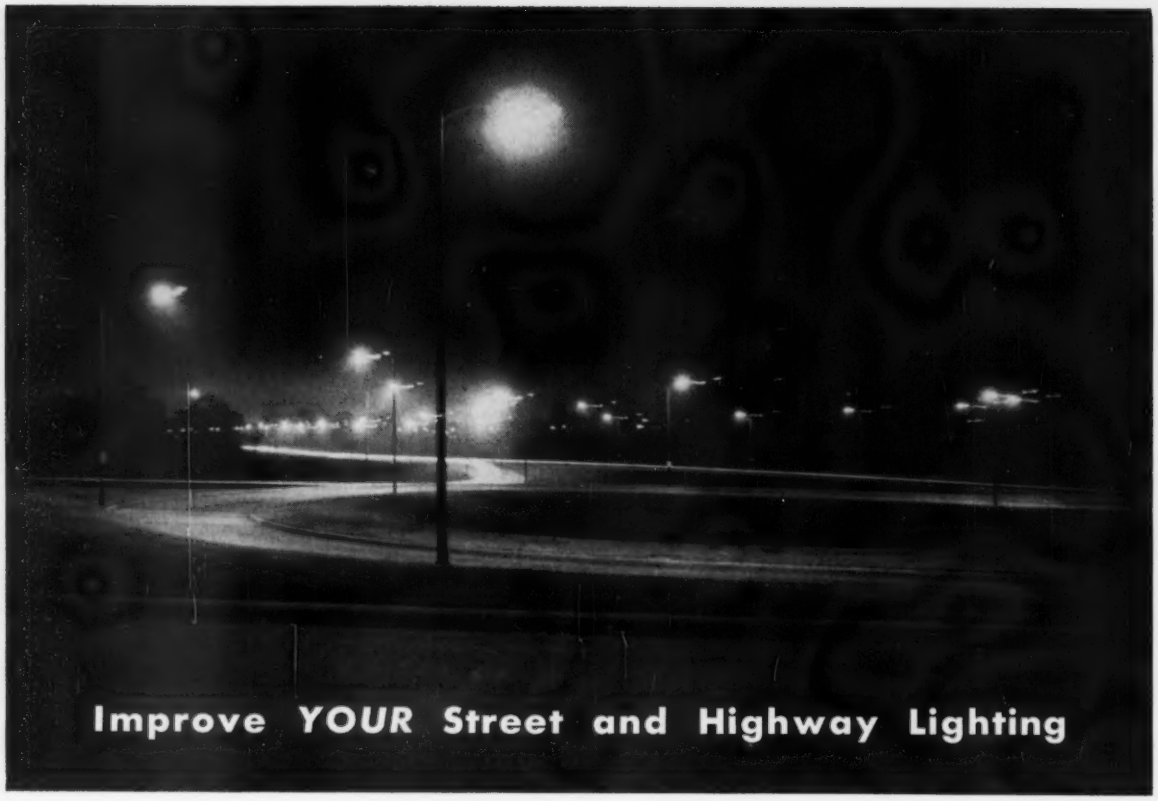
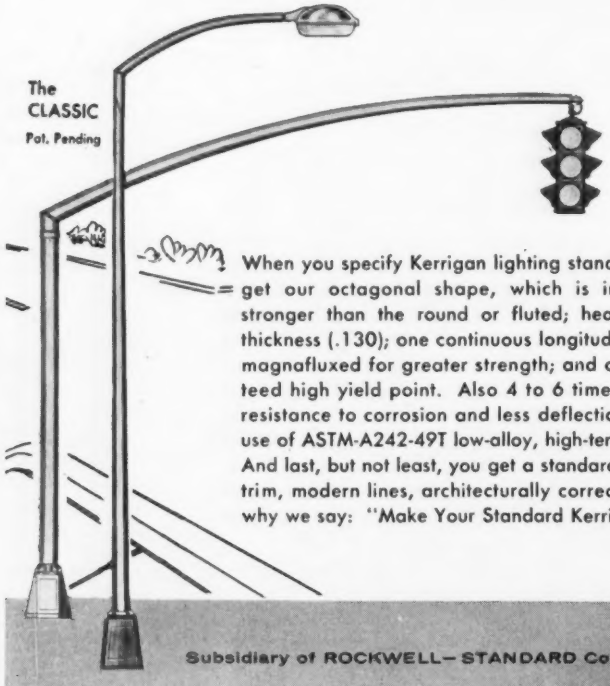


## Improve *YOUR* Street and Highway Lighting

## MAKE YOUR *STANDARD* KERRIGAN




When you specify Kerrigan lighting standards you get our octagonal shape, which is inherently stronger than the round or fluted; heavier wall thickness (.130); one continuous longitudinal weld magnafluxed for greater strength; and a guaranteed high yield point. Also 4 to 6 times greater resistance to corrosion and less deflection by our use of ASTM-A242-49T low-alloy, high-tensile steel. And last, but not least, you get a standard that has trim, modern lines, architecturally correct. That's why we say: "Make Your Standard Kerrigan!"

*Our new 70-page catalog has the engineering facts on both steel and aluminum standards! Won't you write for your FREE copy now? Address: Dep't. E-5.*

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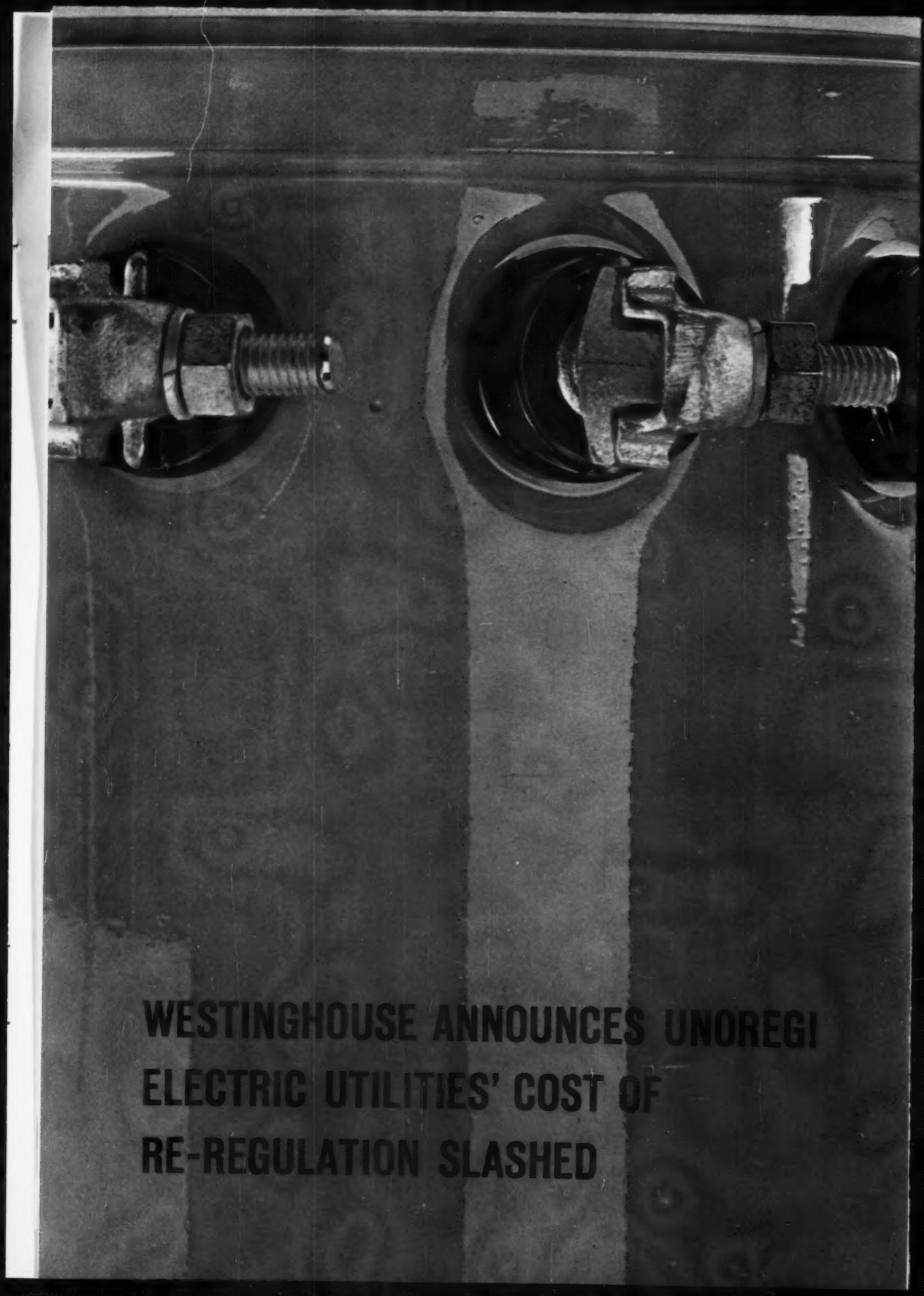


# WESTINGHOUSE ANNOUNCES UNOREGI ELECTRIC UTILITIES' COST OF RE-REGULATION SLASHED

## UNOREG UNIVERSAL VOLTAGE REGULATOR . . . TO BRING ELECTRIC UTILITIES THE LEAST EXPENSIVE, MOST VERSATILE REGULATOR FOR ANY FEEDER DESIGN TESTED, STUDIED OR KNOWN, REQUIRING RE-REGULATION. UNOREG, WESTINGHOUSE NEW AND EXCLUSIVE UNIVERSAL VOLTAGE REGULATOR PROVIDES:

1. IMMEDIATE, ECONOMICAL RELIEF FROM THE CONSTANT PROBLEM OF LOW-VOLTAGE COMPLAINTS
2. A NEW IDEA IN DISTRIBUTION SYSTEM DESIGN, WITH A FLEXIBLE METHOD OF VOLTAGE REGULATION

Unoreg* is a new and vital way of solving the ubiquitous problem of distribution voltage regulation. As loads grow and lines lengthen, re-regulation becomes increasingly important. Supplementary voltage regulation has always been expensive. Here's how Unoreg can bring about an abrupt reduction in the cost of re-regulation:

### ACTUAL CASE...UNOREG SAVES $5861 OF REGULATOR EQUIPMENT COSTS ON A SECONDARY

In this first instance, it will be demonstrated that Westinghouse Unoreg can save the electric utility almost $6000 on regulation. On a typical 4160-volt system, the substation regulator maintains voltage at 125 volts maximum, 120 minimum. Peak load voltage at the end of the distribution line, without re-regulation, is four volts below acceptable minimum. Conventional re-regulation technique would require a 3-phase bank of 50-kva units on the system—with satisfactory service resulting. The cost? A total of $7961 in capital investment.

Let's try Unoreg. First, raise substation bus voltage from 125 to 129 volts. Service to customers at the end of the line will then be adequate. For nearby customers, voltage is too high.

This voltage is then bucked down . . . bucked down . . . by applying Unoreg units to 14 distribution transformers at the head end of the feeder. All customers—all points on the feeder—are at satisfactory voltages, as with conventional equipment. The cost? Fourteen Unoregs, at $150 each, represent a total capital investment of only $2100. Compared to $7961, Unoregs save this system $5861 in equipment first cost. Dramatic savings . . . proved savings . . . and they can be yours!

### AND ANOTHER CASE . . . UNOREG CUTS CAPITAL COSTS $12,000 OR 50%

A 13.2-kv system, with station voltage at 125 volts, is confronted with the same operating problem. Again, conver banks of 19-kva regulators, and one s thus boosted. The bill for regulators in

In applying Unoreg to the problem to 129 volts. Unoregs are placed at bucking regulation. Toward the end of boosting application. Forty units are r same services performed, Unoreg has ment.

### AN OPERATING EMERGENCY... U COMPLETELY SELF-REGULATING

For instance, there's an outage of the h The entire primary feeder circuit is de of the circuit may be supplied from "new" circuit may find itself at the tail feeder. Unoregs in bucking regulation The result is obviously better service emergency conditions.

### HOW YOU CAN USE WESTINGHOU DRASTICALLY CUT RE-REGULATIO

Every utility can point to situations examples given here . . . and remembe

In general, the kva primary feeder square mile govern the need for supple the thermal limit of the primary feeder loadings, represented by any point wit tion. The area above the band represe system design renovation.

### WESTINGHOUSE POWERCASTING REGULATION PROBLEM. FINDS OP FROM AMONG 2,488,320 POSSIBI OF ENGINEERING MAN-HOURS FO

What does it take to deliver a predeter most economical design for distribut What is the optimum combination of voltages to expand the system? What circuits and substations? Where is it system voltages?

Finding the answers to these quest it is a computer-size job. Westinghouse logic, and new techniques of system s distribution system combinations. The ble load patterns . . . peaks, saturatio system voltages and primary feeder de additional data for the problem. All ratings, number of homes per transfor complete the system design data. A to are possible from this complement o casting studies them all.

The computer then designs all ratings, location, costs for all equipm meet design criteria, or prove too cost

*Trade-Mark

# UNOREG...AND A TOTALLY NEW CONCEPT OF DISTRIBUTI

onventional design calls for three 3-phase
one single-phase unit. System voltage is
rs in this arrangement comes to $18,120.
blem, substation voltage is first boosted
at required points near the station—in
d of the line, a few Unoregs are placed in
are required, at a cost of $6000. For the
has saved this utility $12,000 in equip-

## ..UNOREGS BUCK OR BOOST, ARE NG

the high-voltage supply to the substation.
is de-energized. To restore service, parts
rom adjacent feeders. A section of this
tail end rather than at the head end of its
ation here automatically begin to boost.
rvice voltage for your customers under

## HOUSE UNOREG . . . AND ATION COSTS

ons on its own system exactly like the
mber, these were actual cases.
eder loading and load density in kva per
upplementary voltage regulation. Indicate
eeder. Then . . . load densities and feeder
t within the band, will require re-regula-
resents overloading—that requires major

## ING MAKES 3-YEAR ASSAULT ON S OPTIMUM DISTRIBUTION SYSTEM SIBILITIES; TO SAVE THOUSANDS FOR ELECTRIC UTILITIES

letermined quality of service? What is the
ribution transformers and secondaries?
of subtransmission and primary feeder
hat are the optimum load capabilities of
s it practical and economical to regulate

questions is no longer a man-size job . . .
ouse Powercasting, employing computer
em simulation, has determined optimum
The method is, first, to program all possi-
ration and void factors. Various levels of
er design data are fed to the computer as
. All possible distribution transformer
nsformer, and secondary conductor sizes
A total of 2,488,320 complete systems
nt of factors . . . Westinghouse Power-

all these possible systems, calculates
uipment. Those "systems" that do not
costly, are discarded. Final selection by

the computer is that system which provides optimum conditions from bulk power source to customer, and total cost.

In Powercasting, Westinghouse makes available to the electric utility industry a major new tool for distribution system planning . . . accurate, dependable, long-range.

## UNOREG'S 1¼- AND 2½-KVA MODELS TO BLANKET REGULATION NEEDS FOR TRANSFORMERS RATED 1½-50 KVA

Unoreg is completely separate from the distribution transformer. Ease and flexibility of application are evident. Two models handle 8 transformer kva ratings. Inventory costs are at a minimum. When the regulator is built into the transformer, obviously all 8 ratings must be stocked. Taking into account all primary voltages, Unoreg, in just two ratings, can be applied to 603 styles of transformers.

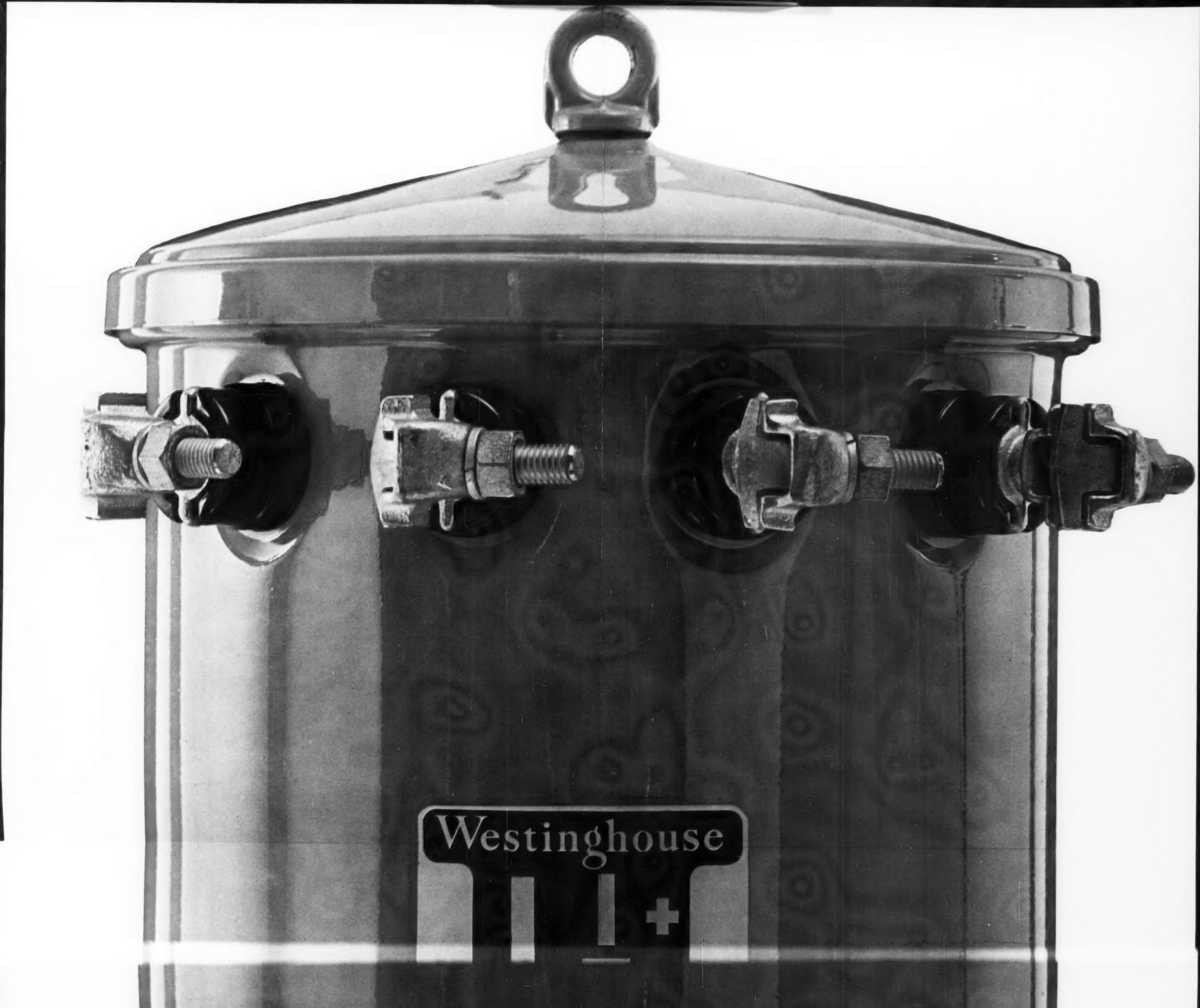
And here are additional, and specific, cost savings. This 1¼-kva Unoreg can be installed on an existing transformer at an equipment cost of only $150 plus installation. The cost of replacing a transformer-with-built-in-regulator unit includes the higher expense of changeout, and the premium price of the new combination equipment. So Unoreg can be instrumental in lowering your total system costs.

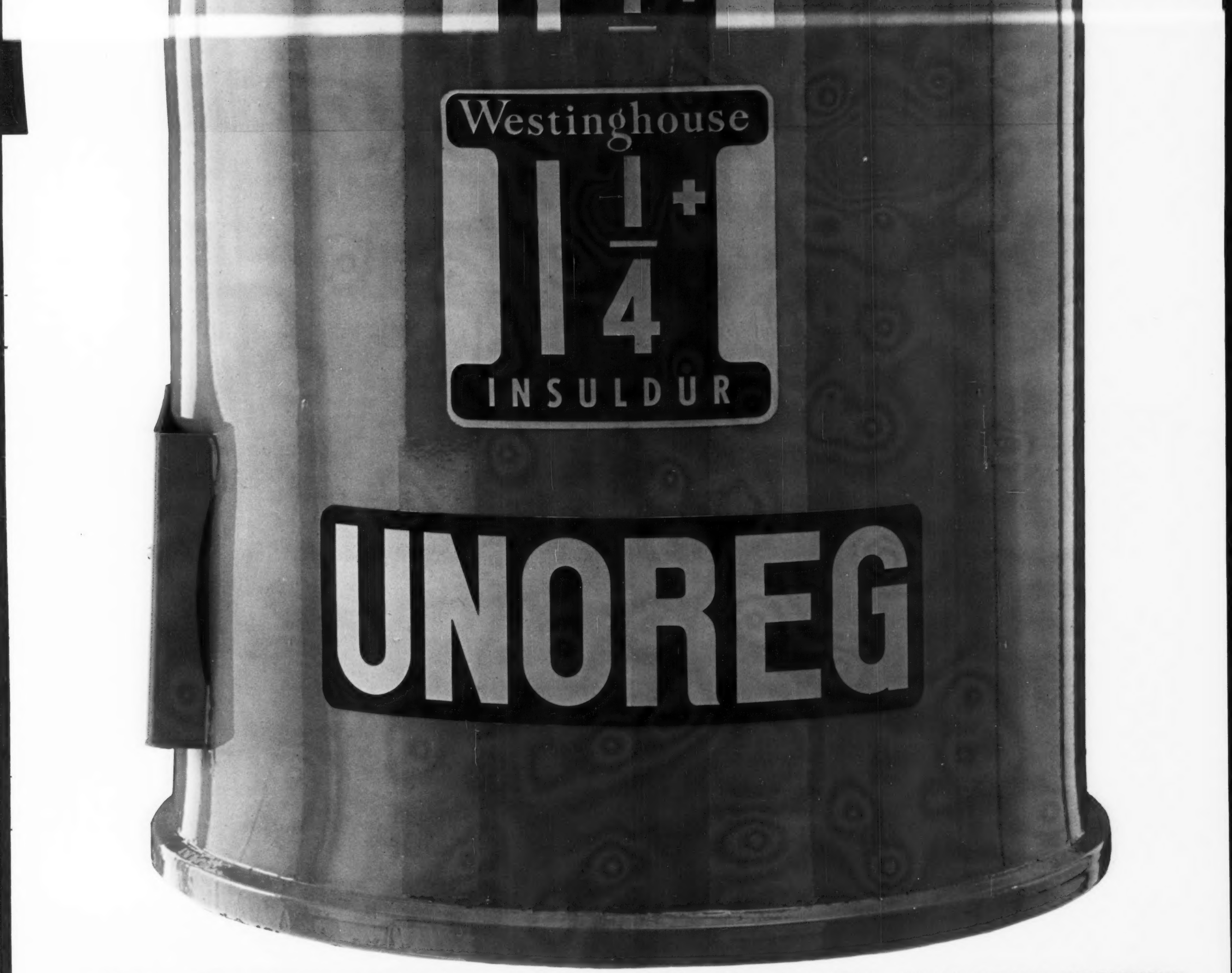
At a later date, Unoreg can be put in service at a second location without disturbing the transformer to which it was originally applied. This fact is difficult to price, but system operators will welcome this flexibility for temporary emergencies or changing voltage conditions. Or, Unoreg can serve any individual load when required, such as a farm or end-of-line customer . . . again flexibility for spot situations.

## UNOREG MAINTAINS 2½-VOLT EFFECTIVE BANDWIDTH UP TO 180% OF TRANSFORMER RATING

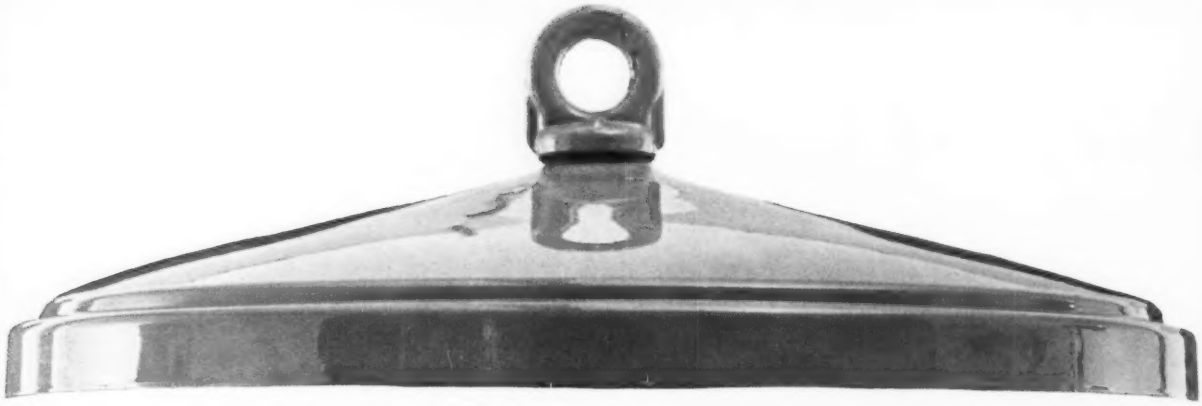
On secondaries of 120/240 volts, Unoreg will provide a plus or minus 5% voltage regulation at point of consumption—a 2½-volt bandwidth. Unoreg can be operated up to 180% of its nameplate rating . . . with no loss of normal service life.

# TION VOLTAGE REGULATION...SLASH CAPITAL INVESTMENT

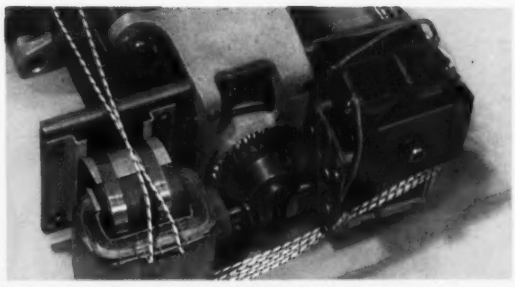

Westinghouse



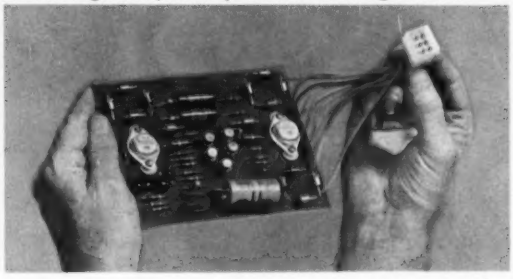

UNOREG...AND A TOTALLY NEW CONCEPT OF DISTRIBUTION VOLTAGE REGULATION...SLASH CAPITAL INVESTMENT



Changeout control quickly by merely unplugging and removing.



Induction regulator operates by direct drive from a gearmotor.



Voltage control element is a solid state, completely integrated relay.

**UNOREG IS COMPLETELY SELF-PROTECTING.** Unoreg is an induction regulator and is operated by a gearmotor. There are no moving parts or taps except the plus-minus 90-degree rotation of the rotor, and parts of the gearmotor. Insulation meets the 30-kv BIL of the transformer. Bushing gaps protect the rotor-stator assembly from lightning.

The voltage control element is a solid-state, integrated relay with no moving parts or contacts. Components are temperature-compensated for precise control at all ambients. For maximum safety, the control transformer isolates the device from abnormal voltages.

**COMPACT, STANDARDIZED FOR FAST, INEXPENSIVE INSTALLATION.** The 1¼ kva Unoreg is only 21" high, 12¼" in diameter. Standard low-voltage distribution transformer bushings are color-coded for quick, easy connection—brown for input, green for output. Tank-mounting bracket has standard 12" spacing for bolt holes . . . the same as those of the transformer. Simplifies installation. Protecting this compact equipment is Westinghouse famed Coastal Finish which will stand up to the worst of weather conditions.

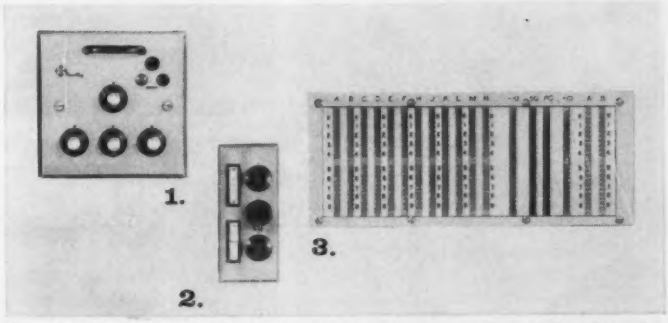
You'll want to know more about Unoreg and how you can take advantage of these huge savings. Call your Westinghouse representative . . . he has the information.

YOU CAN BE SURE...IF IT'S **Westinghouse**

LITHO IN U.S.A.

# Hagan PowrMag Analog Computer Control

*simple as*




PowrMag systems embody the highest degree of flexibility. Simple, efficient electrical design utilizing long-lived and trouble-free solid state components, and rugged mechanical construction suit the system for a variety of industrial process control applications.

## 1. *Magnetic Control Unit*

This magnetic amplifier, operating on 1-9v DC, may be used individually, as a single 2 or 3 mode controller, or as one element in a large system. Each control unit may be removed from the front of the panel for easy interchangeability. The basic unit is easily converted to other modes by the addition of interchangeable, plug-in circuits for *all* common control operations. Inventory is reduced to the one basic unit. Unaffected by shock or vibration, PowrMag has no moisture, dirt, leakage or freezeup problems—3.5 watts of unregulated 110v, 60 cycle AC. Size—5¼" x 5¼".

## 2. *Remote Control Station*

These stations provide for remotely established set points and required manual control operations. Full station may contain two single or ganged potentiometers, one switch and two meters. Size—2¼" x 5¼". Half stations available with set point, bias or ratio dial and output signal indicator. Size—2¼" x 3⅛". Each station uses 12-wire, color-coded electric cable with MS-type connector. Front mounting and removal make it ideal for the compact console installations required for centralized control.

## 3. *Patchboard*

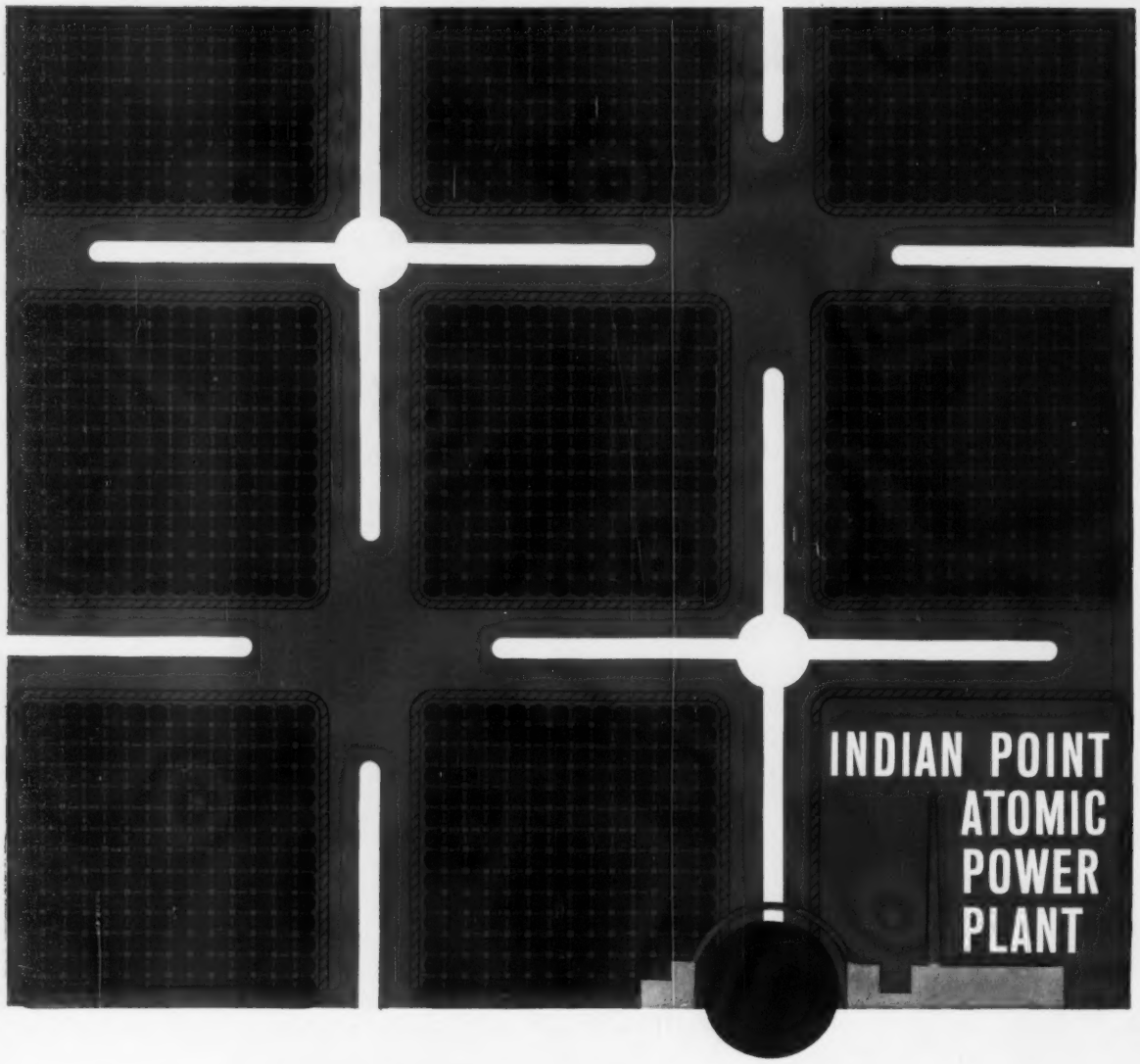
Interconnecting the system in any desired manner, via color-coded electrical cable, the patchboard requires no solder connections or terminal boards—all connections are made by special taper pins. Each connection is identified by an alphanumeric combination. Numbers, run vertically, identify the components in the system, such as magnetic amplifiers, controllers, transducers, etc. Letters, run horizontally, identify the connectors leading into the patchboard. DC control power bus is in the center section—no AC voltages are used in the patchboard.

Easy front access permits simple changing of operations. Additional loops or components are readily added to the system.

A letter or phone call will bring you complete information on the PowrMag system. **Ask for Bulletin MSP-163.**

**HAGAN**
**CHEMICALS & CONTROLS, INC.**
HAGAN CENTER, PITTSBURGH 30, PENNSYLVANIA

**HAGAN** DIVISIONS: CALGON CO. — HALL LABORATORIES — BRUNER CORP.




# USING MALLINCKRODT URANIUM–93% ENRICHMENT

This reactor, as well as those of Commonwealth Edison Company and Yankee Atomic Electric Company, depends upon commercially produced nuclear fuels. The uranium loading of all three will be entirely or partly Mallinckrodt $UO_2$. ◆ The Indian Point reactor, designed and manufactured by Babcock and Wilcox Company, will use over 2000 pounds of Mallinckrodt $UO_2$ (93% enrichment). The balance of the fuel will be thorium oxide. This 275,000-kilowatt plant is owned by Consolidated Edison Company. ◆ Whether power, propulsion or experimental—domestic or overseas—Mallinckrodt has unequaled experience in producing uranium fuel materials. Mallinckrodt now offers over fifteen different forms of uranium compounds and metal . . . and can deliver completed fuel elements by working with metal fabricators. For consultation on your nuclear fuel problems, write or call Mallinckrodt.

**MALLINCKRODT NUCLEAR CORPORATION • ST. LOUIS 7, MO.**

THE WORLD'S FIRST AND LEADING PRODUCER OF NUCLEAR FUELS

Why utility engineers now specify

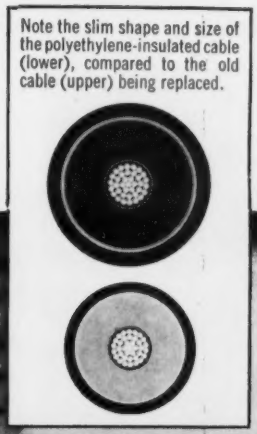
# POWER CABLE INSULATED WITH MONSANTO POLYETHYLENE

• better abrasion resistance • lower power factor; less power loss in transmission • low surface tracking • excellent moisture resistance • less bulk, less weight

Leading manufacturers now produce power cable insulated with polyethylene based on Monsanto Polyethylene resins, specially developed and perfected by Monsanto. For complete technical data including applicator's information, write to Monsanto Chemical Company, Plastics Division, Room 730, Springfield 2, Massachusetts.

Monsanto®

**MONSANTO** ACTIVATOR IN **PLASTICS**



Note the slim shape and size of the polyethylene-insulated cable (lower), compared to the old cable (upper) being replaced.

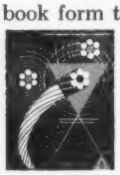
New 15,000 volt polyethylene-insulated power cable installation at main sub-station, Monsanto Chemical Company, Plastics Division plant, Springfield, Massachusetts. Installation-rated at 175 amps, 15,000 volts. 3-phase system, 1 conductor per phase. Conductors are 133,100 circular mil copper, with 37 strands. Insulation consists of: 1 layer black fiberglass tape, 297 mil polyethylene insulation, metal shielding, 6/64" vinyl jacketing.

# for the latest data on ACSR

## 126 fact-filled pages...from Alcoa

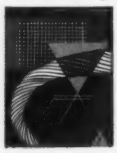
It took more than 60 years to prepare these three publications.

Recently completed tests have made it possible to review and revise data accumulated since 1897, the year Alcoa launched a continuous research program on overhead aluminum conductors— *both all-aluminum and ACSR*. The most up-to-date information has been put into book form to help you in your job:



Design or operation of transmission lines is your problem. Maybe you're called on to predict the resistance and reactance of a proposed transmission line. Are available data good enough? This 90-page book supplies you with new information on resistance and reactance—information that can help you accurately evaluate the effects of the steel core on electrical characteristics. TITLE: *Resistance and reactance of aluminum conductors.*

How much heat loss can you expect from convection? Tough problem. One that's complicated by the chimney effect of a heated conductor. And varying wind conditions. This 20-page publication provides up-to-date information on heat dissipation caused by convection and radiation. TITLE: *Current-temperature characteristics of aluminum conductors.*



Electrical requirements on your system go up. You need to operate conductors at higher temperatures than in the past. You ask yourself: what about creep effect? Here's a 16-page booklet that provides easy-to-use answers to many questions on how aluminum conductors behave when subjected to various conditions of heating by high overload currents. TITLE: *Overload and fault current limitations of bare aluminum conductors.*

Ask any one of our representatives for your copy of these new publications. Written requests on company stationery should be mailed to Rome Cable Division of Alcoa, Dept. 1-50, Rome, New York.

**ROME CABLE**
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# Specify ELKONITE® Contacts for trouble-free service in oil circuit breakers

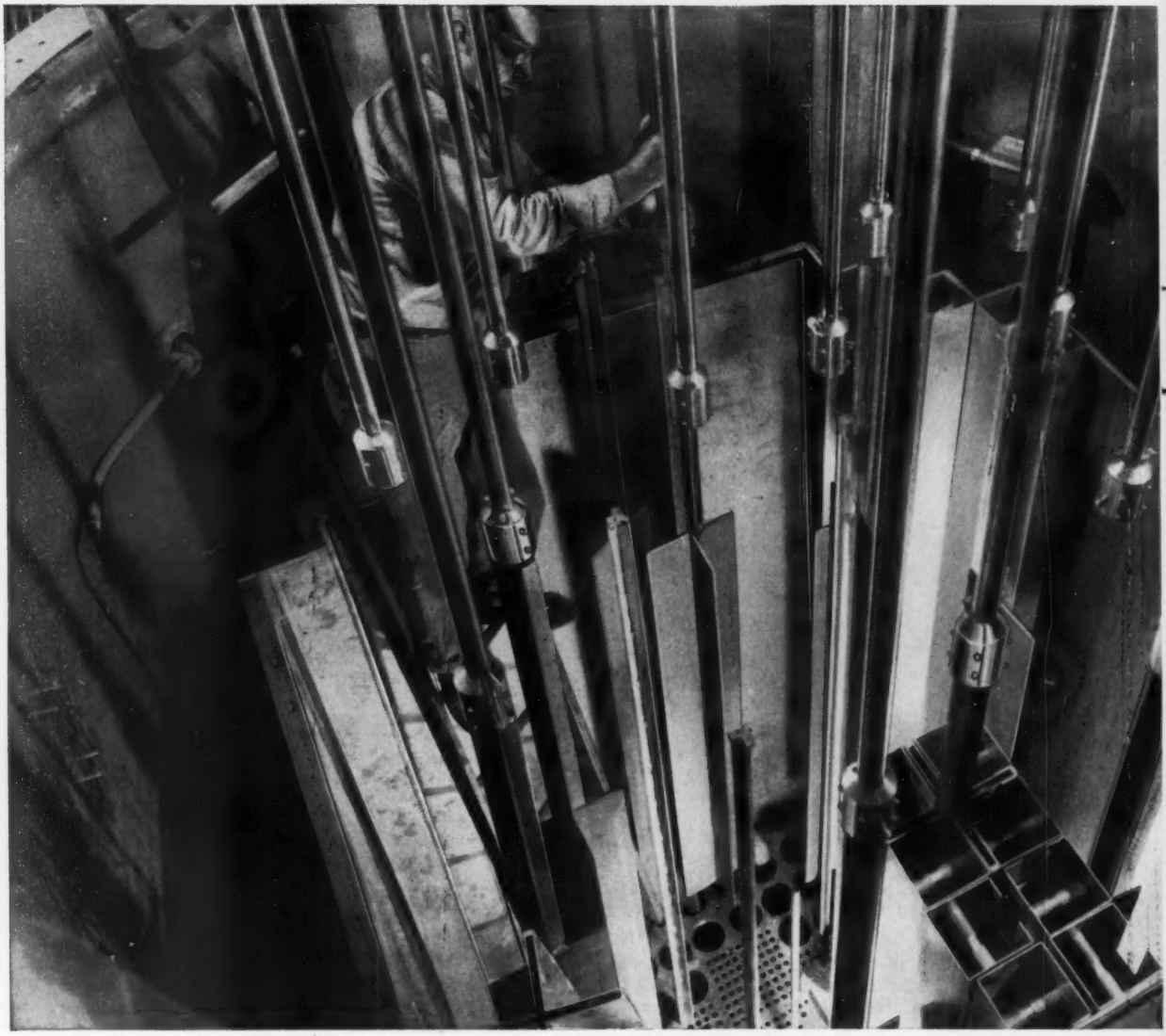
Trouble-free performance in oil circuit breakers calls for the best in contacts . . . rugged Mallory Elkonite contacts. They have the high resistance to wear needed for frequent make-and-break operation . . . plus outstanding arc erosion resistance. You can depend on Elkonite contacts to handle your toughest jobs day after day and year after year, because they are always engineered to exact performance requirements. Specifying Elkonite contacts for your circuit breakers will pay off with long, satisfactory service life.

Elkonite utilizes Mallory's pioneering in powder metallurgy techniques and years of contact specialization to combine high-conductivity metals with heat-resistant refractory materials. Elkonites are part of Mallory's broad line of 147 different contact materials covering the entire range of conductivity, mechanical strength, arc erosion resistance, density and hardness. Manufacturing processes are precisely controlled to produce the optimum combination of characteristics for each contact application.

Top performance and unequalled service life in those "tough" jobs make Elkonite contacts the first choice of leading manufacturers of circuit breakers, voltage regulators and other equipment. To make sure you get these qualities, insist that your supplier use Elkonite contacts in the apparatus you buy.

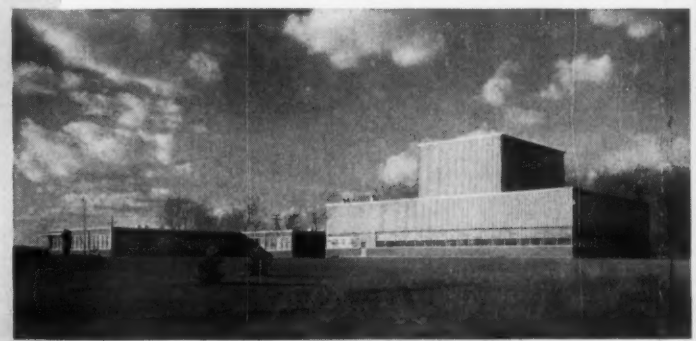
*From generator to user,*
*Mallory contacts serve the nation's utilities . . .*

Mallory Metallurgical Co., Indianapolis 6, Ind.
*a division of*
P. R. MALLORY & CO. Inc.
MALLORY



**CRITICAL FACILITY TANK** at Greendale Laboratories measures 12 ft deep with a 9-ft diameter.

Allis-Chalmers
has had a major stake
in the power industry
for over 60 years



**ALLIS-CHALMERS GREENDALE RESEARCH** and development center for nuclear power includes the critical facility containing a full-scale mock-up of the Pathfinder reactor.

# Trailblazer for Pathfinder

## Full-scale critical facility speeds nuclear superheat calculations at Allis-Chalmers Greendale Laboratories

When this reactor at Allis-Chalmers nuclear test facility "went critical" *on schedule* late in 1959, a big step was taken toward successful completion of the world's first power reactor with integral nuclear superheat. The initial use of this valuable research tool will be for studies of the reactor core for Pathfinder. This controlled recirculation boiling water reactor is owned and will be operated by Northern States Power Co., Minneapolis, Minnesota.

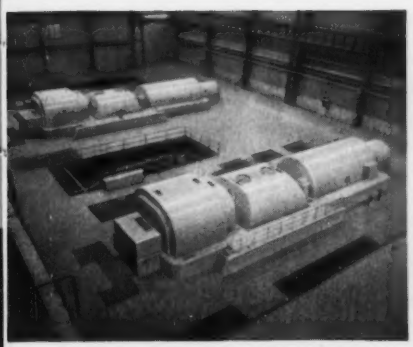
This is just one of the major test facilities at Greendale Laboratories. Others include a steam separator test loop, complete facility for developing underwater handling techniques, a battery of corrosion loops, heat-transfer loops, water purification filter tests, and other experimental facilities.

These modern development facilities round out the comprehensive service Allis-Chalmers offers the nuclear power field. In addition to broad engineering and production capacity—plus more than a half-century's association with electrical power generation, transmission and distribution — Allis-Chalmers has a staff of specialists experienced in reactor design, construction, and operation. Here is a source of complete responsibility from investigation to start-up.

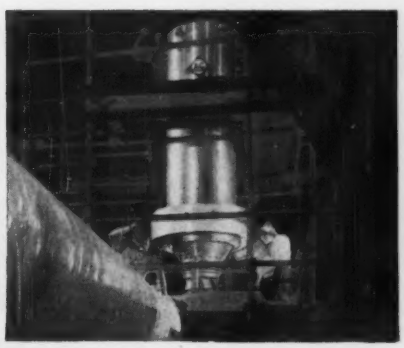
**Ask for new facilities book 43B9541** — This 28-page brochure covers different reactor designs, laboratory and production capabilities. *See your Allis-Chalmers representative, or write Atomic Energy Division,* **Allis-Chalmers,** *Milwaukee 1, Wis.*

**ALLIS-CHALMERS**

A-1246

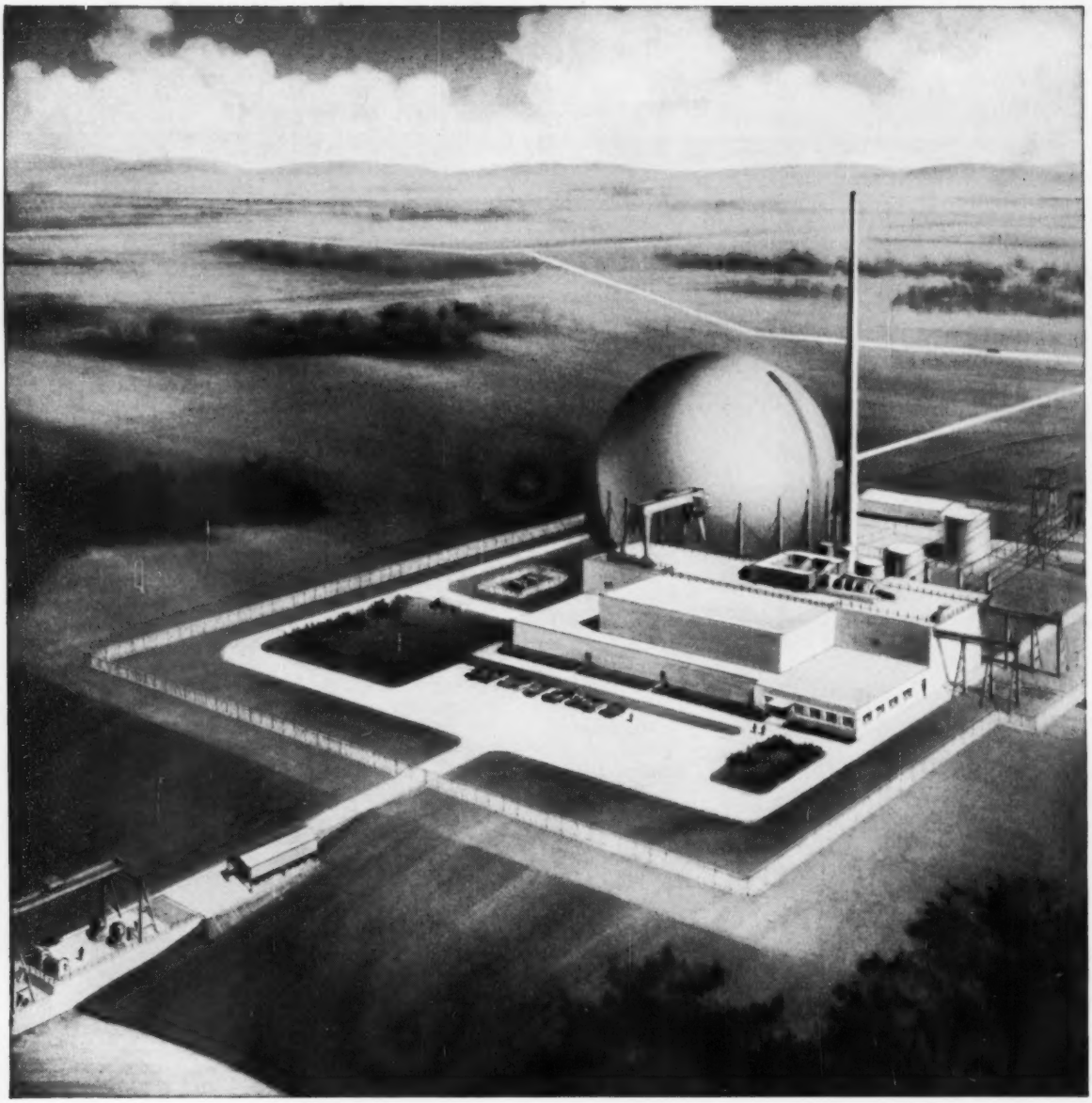


**A-C TURBINES AND CONDENSERS** operate efficiently in many of the country's major central stations.



**A-C PUMPS OF ALL TYPES** serve important conventional and nuclear plants on all types of auxiliary service.

**COMPREHENSIVE WATER CONDITIONING SERVICE,** in laboratory and field, includes equipment and chemicals.



*Concept of a 306 MW boiling water nuclear power plant, the result of a design study for the U. S. Atomic Energy Commission, symbolizes Ebasco's competence in nuclear engineering and the company's 54-year reputation for outstanding quality in diversified engineering and construction work.*

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# Announcement!

new complete line of O-B stacking posts brings you unique features of design . . . convenience . . . economy

see next 3 pages

10005-H

# New O-B post...goes anywhere in

**A FEW QUICK FACTS . . .**

There is only a single O-B Unipost unit of any given strength and electrical rating. This unit can be placed at top, bottom, or intermediate position in the stack because all its bolting dimensions are interchangeable.

Since Unipost units can be combined universally, one spare unit in inventory replaces three of specialized design. And in construction, no attention need be given to unit position when stacks are built.

All Unipost stacks are symmetrical. No mixed ratings are combined to attain the desired BIL. Every stack is built with two, three, or four identical units. Again, a saving in inventory is effected. Construction and maintenance are simplified.

Industry standard top and bottom bolting provisions permit mounting on any existing structure, and accommodate any switchgear base or bus support.

Complete new factory equipment - - including the industry's latest advances in ceramic manufacture - - are used for production of the new O-B Unipost. High and consistent performance in service are the result of good design and exceptional facilities to reproduce it.

The O-B Unipost is available in three ranges of mechanical ratings: standard strength, high strength, and extra-high strength. All BIL's are represented.

See the following page for the most interesting detail of Unipost design - - the one that saves you money and trouble.

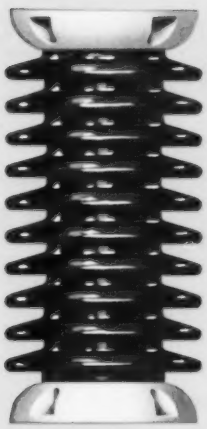
**Interchangeable O-B Unipost simplifies construction . . . reduces inventory . . . fits all standard industry dimensions**

Ohio Brass

HOLAN

PORCELAIN INSULATORS · LINE HARDWARE · CAPACITORS · LIGHTNING ARRESTERS
BUSHINGS · HOLAN TRUCK MOUNTED POWER DEVICES AND BODIES · BRONZE VALVES

# a stack



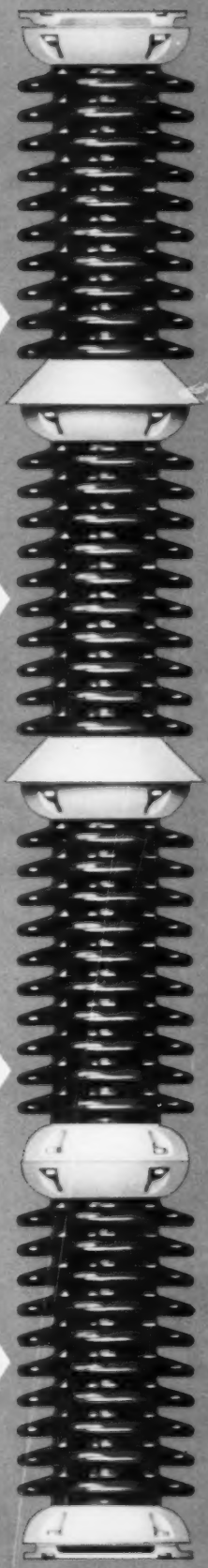
*the same* ***UNIPOST UNIT***

FITS HERE

AND HERE

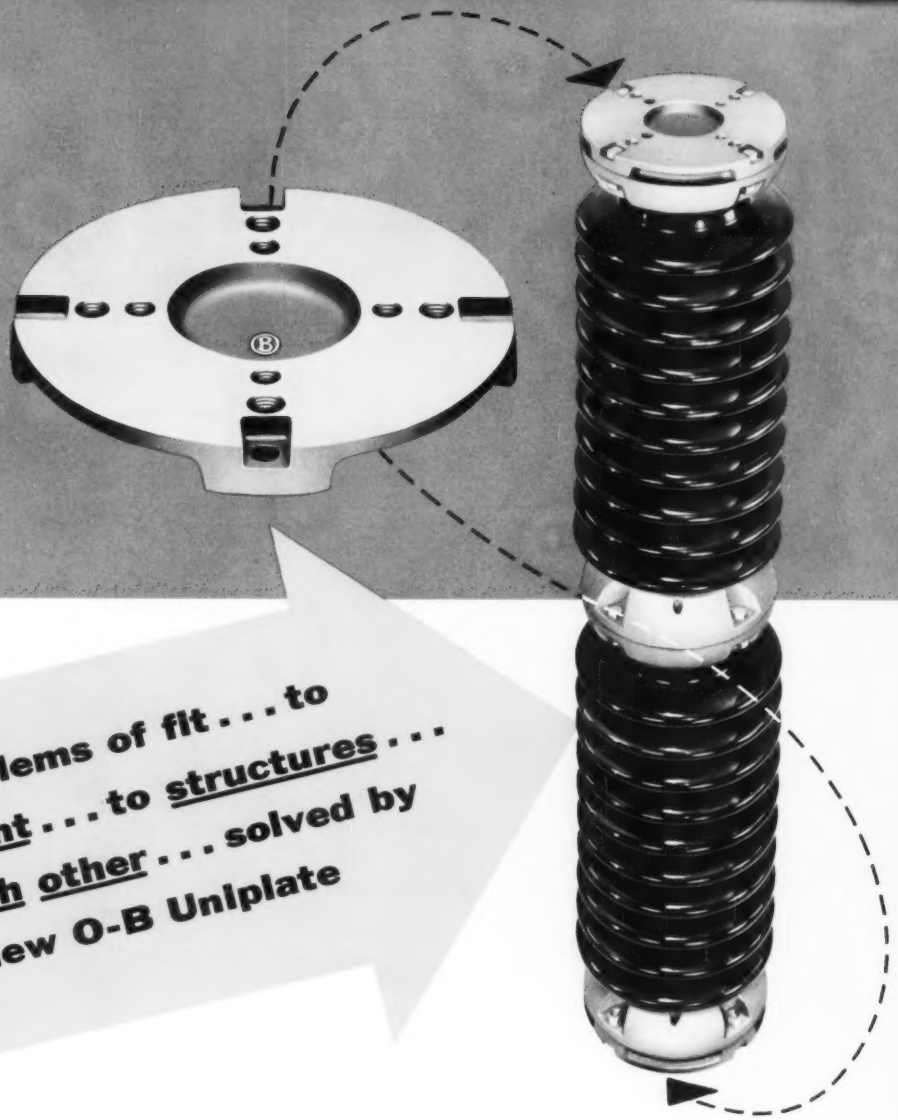
AND HERE

AND HERE



10066-H23

# Posts "go modern"



**Problems of fit . . . to equipment . . . to structures . . . to each other . . . solved by new O-B Uniplate**

"Give us an *interchangeable* stacking post insulator!" is what many power company engineers have told us. Here it is - - the new O-B Unipost - - and here is how it's done.

Strength requirements dictate the geometry of the mounting base. These dimensions naturally must prevail throughout the stack to effect universal combination. Because switchgear, bus supports, etc., may be drilled to different bolt circles - - and this may also apply to station steelwork - - Uniplates at top and bottom are an integral part of every O-B Unipost stack. Thickness of these plates is included in arriving at standard stack heights. Therefore, no difficulty will be encountered in applying the new Unipost.

Conventional post insulator design restricts freedom of bolt circle selection. The Uniplate provides universal fit with any existing structure or any top attachment, independent of the insulator's own mounting dimensions.

The name "Unipost" truly expresses the fundamental design of this new O-B station post insulator - - universal in its stack location - - universal in its ability to fit your construction and station equipment.

Your O-B representative will be glad to fill-in other important details. This new post is now in regular manufacture and ready for shipment - - ready for those men who have been waiting for the stacking post to "go modern."

OHIO BRASS COMPANY, MANSFIELD, OHIO

*Ohio Brass* (B) HOLAN

PORCELAIN INSULATORS · LINE HARDWARE · CAPACITORS · LIGHTNING ARRESTERS
BUSHINGS · HOLAN TRUCK MOUNTED POWER DEVICES AND BODIES · BRONZE VALVES

10005-H4

Oshawa Shopping Center,
Oshawa, Ontario, Canada.

Tip Top Mart, Canton, Ohio.

Sears, Roebuck Store, Tampa, Florida.

Southgate Shopping Center, Cleveland, Ohio.

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# Area Lighting with Monotube Poles offers you unmatched design choice in steel or aluminum

Union Metal engineering assistance is available to help you select the most appropriate lighting pole design combining economy and good appearance.

**THE UNION METAL MANUFACTURING COMPANY**

*Monotube Area Lighting Poles*

Canton 5, Ohio • Brampton, Ontario, Canada

# HIGH-PRECISION SERVO TRANSDUCER

NEW FROM BRISTOL

CONVERTS MEASUREMENTS LIKE THESE:
Pressure
Absolute pressure or vacuum
Differential pressure
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Temperature
Linear motion
. . . and many others

INTO

SHAFT POSITION FOR OPERATING:
Transmitting slidewires
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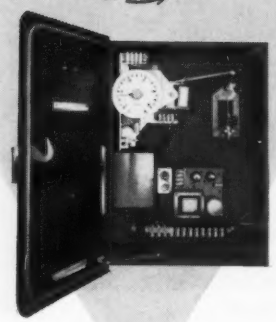
Alarm switches
Analog-to-digital encoders
Upset contacts
Limit switches
Deviation contacts
. . . etc., etc., etc.



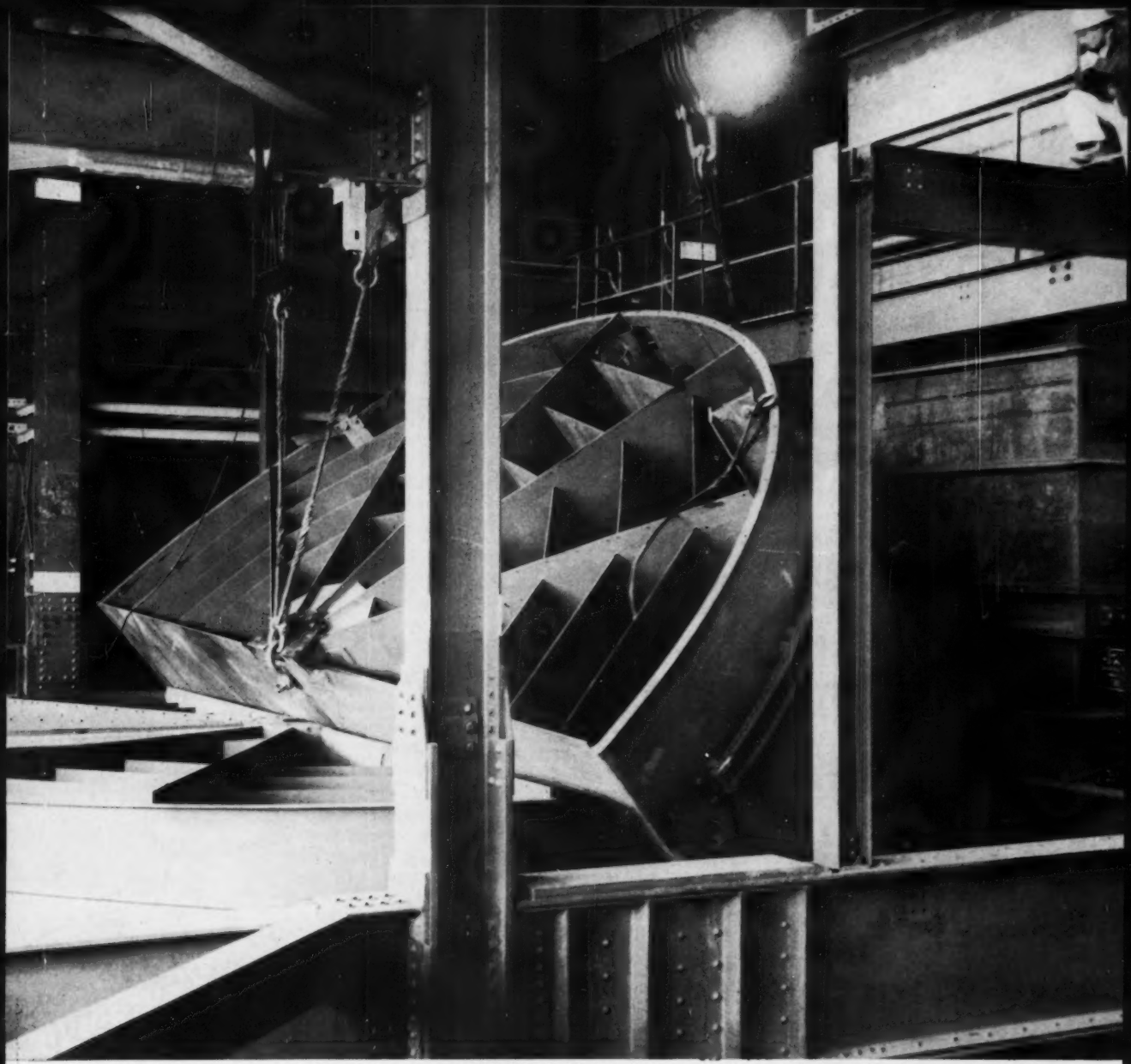
**New Bristol Dyna-Servo Transducer** uses same convenient panel-type packaging as regular instruments, adds new flexibility to instrument system design.

## A precision feedback package . . . easy to use as a regular instrument

It's the new Bristol Dyna-Servo Transducer, a high-torque, electronic servo unit that converts position or measurements into precision shaft angle . . . uses same highly accurate, service-proved electronic system as famous Bristol Dynamaster* potentiometer and bridge instruments . . . works with high-precision Bristol measuring elements, long known for accuracy, sensitivity, stability. Write for complete technical data on this new Bristol contribution to instrumentation flexibility. The Bristol Company, 116 Bristol Road, Waterbury 20, Conn.

*T.M. Reg. U.S. Pat. Off. 9.27

**BRISTOL** . . . for improved production through measurement and control
AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS



*Half of Ljungstrom rotor is lowered into place at Philadelphia Electric Co.'s new Eddystone Station. When heating element baskets are fitted into the rotor chambers, this unit will provide 201,100 sq. feet of heat transfer surface and will weigh about 535,000 lbs. It will be one of four air preheaters serving a 325,000 KW unit. Two such boiler units are presently being installed.*

## SAFEGUARDING EDDYSTONE'S **NEW LJUNGSTROMS®** **—LIFETIME AIR PREHEATER SERVICE**

Dependability is standard equipment in Philadelphia Electric Co.'s new Ljungstroms. Each unit is protected by Lifetime Air Preheater Service. That means that *throughout the life of each unit,* Air Preheater engineers make regular calls to inspect the Ljungstroms and keep them in top operating condition.

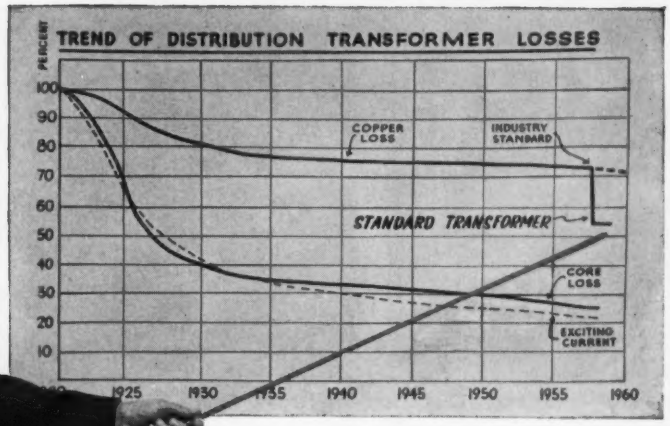
Air Preheater also shows lively, consistent interest in their *factory* service to customers. For example, when a midwest customer recently ordered emergency replacement elements, Air Preheater's traffic department investigated the cost, speed and control of all commercial shipping methods. In the circumstances, regular trucking would take too long, rail delivery was impractical, other methods prohibitively expensive.

So Air Preheater asked for authorization to ship the replacement elements aboard one of their own trucks. The result: the elements arrived a week in advance of the hoped-for date — and, thanks to Air Preheater's efforts, the customer made significant savings on transportation costs.

In addition to regular field service and fast, competent factory service, Air Preheater offers you over 35 years of experience in solving boiler and preheater problems. These reasons help explain why 19 of the 20 most efficient power stations in the U.S. are Ljungstrom-equipped.

**THE AIR PREHEATER CORPORATION**

*60 East 42nd Street, New York 17, N. Y.*


TREND OF DISTRIBUTION TRANSFORMER LOSSES
PERCENT
100
90
80
70
60
50
40
30
20
10
1925
1930
1935
1940
1945
1950
1955
1960
COPPER LOSS
INDUSTRY STANDARD
STANDARD TRANSFORMER
CORE LOSS
EXCITING CURRENT

10
Standard

*"... no TV picture shrinkage ..."*

*"... sure starts on farm and home equipment ..."*

*"... better regulation ..."*

*"... better voltage at the entrance switch ..."*

# "The most important design advance since grain-oriented steel"

Clever design and efficient use of materials have made the all-new Standard SWA Distribution Transformer the most talked about transformer in the field today. Utility engineers estimate that 3% to 4% of peak load is represented by distribution transformer losses. The SWA slashes copper losses by a dramatic 30%! This new transformer reduces "unaccounted for" KWH; increases revenue by better regulation; and, because lower losses produce a slower temperature rise, the SWA will carry overloads safely. Your nearby Standard Transformer representative can show you what the SWA's can do on your system and how they pay for themselves.

Now is the time to put the SWA on test. Measure the results to your own satisfaction . . . compare them with conventional units. Our own figures are documented in Standard Bulletin S-401-C. They verify what engineers have suspected for years . . . that a transformer with radically lower copper losses, lower impedance to reduce voltage drops, and improved thermal time constant to permit overloads without excessive heating could be produced at a realistic price. It has been done and it was done FIRST at Standard.

Write for Standard Bulletin S-401-C today. It tells the complete story on the all-new SWA distribution transformer and shows how to determine the increased profit it can produce on your system.

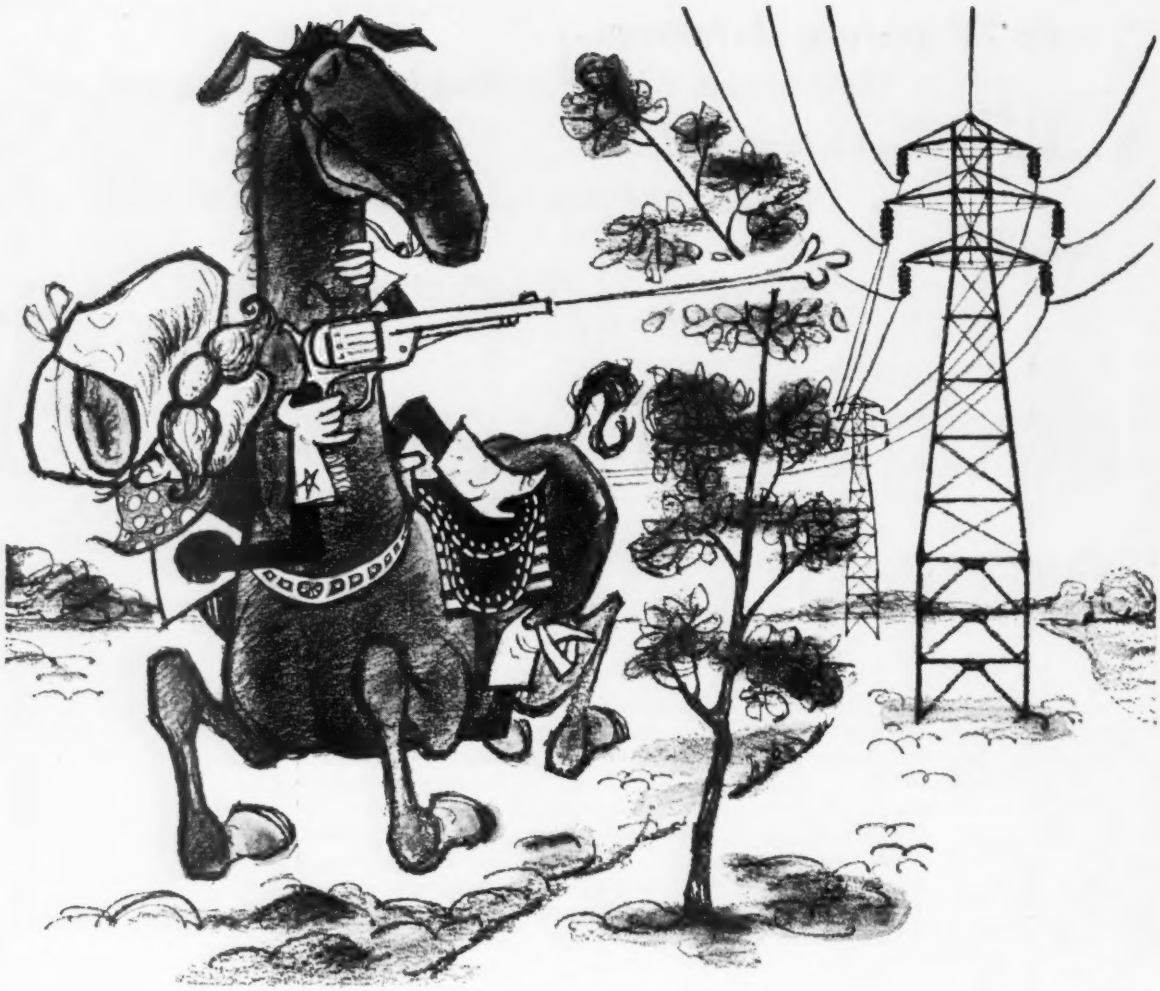
Phone WARREN
EXpress 2-1563

40 years of concentration on transformer design exclusively

**Standard Transformer CO.**

WARREN, OHIO

"WHEREVER THERE IS POWER"



# Meet the LINE RIDER from the Diamond Spread

THE LINE RIDER AND HIS GANG of Diamond Chemical killers are deadly (for weeds and brush, that is). They're inexpensive killers, too . . . and can save your department thousands of dollars a season.

FOR MIXED BRUSH—LINE RIDER LV-3D/3T, a 2-Ethyl Hexyl Ester formulation of 2,4-D and 2,4,5-T containing 3 pounds each of acid equivalent per gallon.

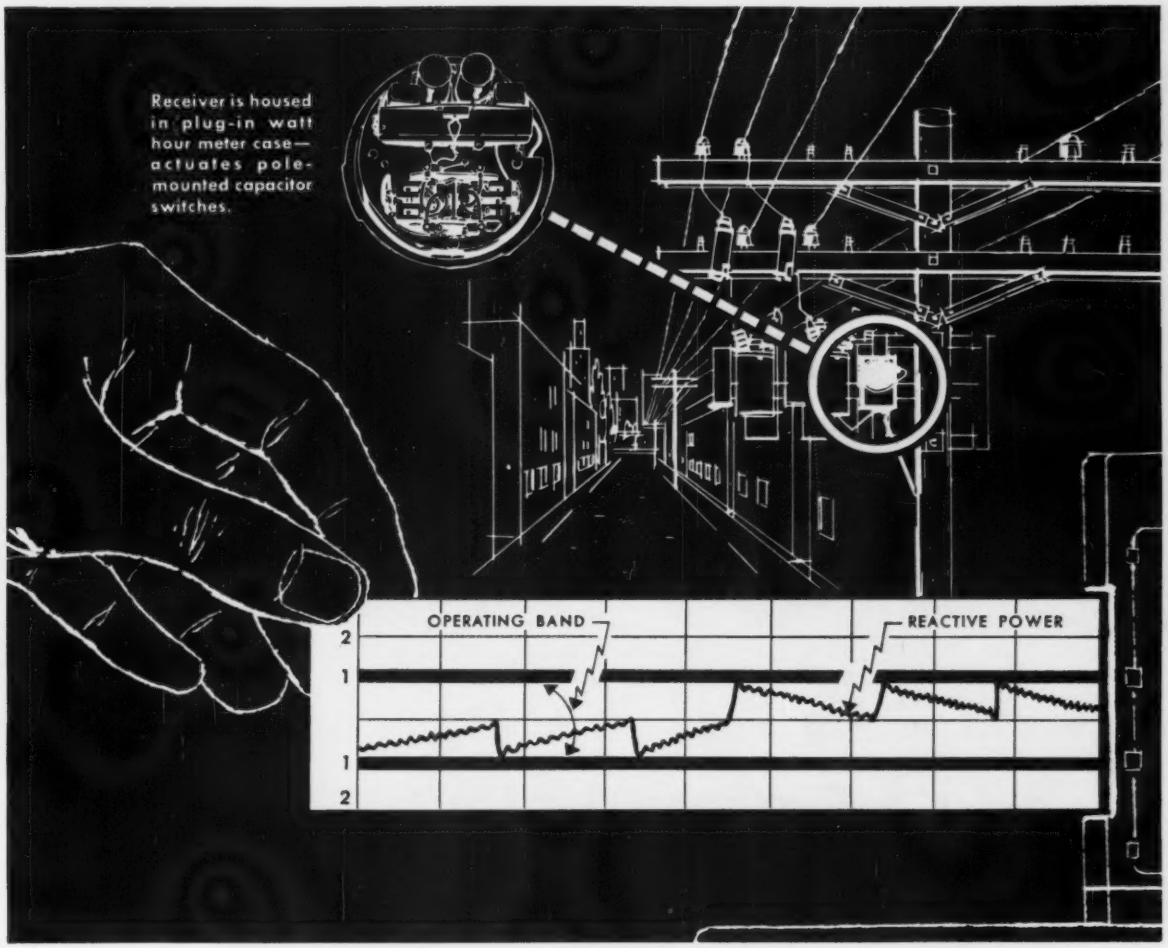
FOR MAPLES AND OAKS—LINE RIDER LV-6T, a 2-Ethyl Hexyl Ester formulation of 2,4,5-T containing 6 pounds of acid equivalent per gallon.

FOR AREAS ADJACENT TO SENSITIVE CROPS—LINE RIDER AMINE 22, alkyl amine salt formulation of 2,4-D, and 2,4,5-T containing 2 pounds each of acid equivalent per gallon. Applied as a water-borne spray.

FOR SPECIAL CONDITIONS—Also available are other standard LINE RIDER formulations, including Butyl and Low Volatile Esters of 2,4-D and 2,4,5-T containing 4 pounds of acid equivalent per gallon.

If you want deadly marksmanship, send for new LINE RIDER brochure giving details. Write Diamond Alkali Company, 300 Union Commerce Building, Cleveland 14, Ohio.

Diamond Chemicals




# MOTOROLA *CENTRALIZED CONTROL* MAKES THE BIG DIFFERENCE IN AUTOMATIC CAPACITOR SWITCHING

**Maintains system stability.** Reactive power in the distribution system is kept within a narrow pre-set operating band. Substation equipment acts immediately to add or remove banks in a pre-set sequence. No local over-correction is possible. An automatic system check assures maintenance of the desired status of all capacitor banks.

**Achieves aim of conventional systems—overcomes their limitations.** Motorola CC-10 Capacitor Switching, by continuous monitoring and switching capacitors when and where needed, maintains optimum power factor throughout the entire distribution system. Result: reactive current is reduced to a minimum; voltage is maintained at the desired value on a system-wide basis.

**Lowers equipment and maintenance costs.** Motorola CC-10 Capacitor Switching also allows you to maintain voltage without expensive tap-changing and regulating equipment. Because you can put more revenue producing kilowatts through your present system, expensive additional new construction can be deferred.

**But that's not all.** Pole-mounted receivers are fully *transistorized* for long, trouble-free operation. System security against false operation is a field-proven fact—components are Motorola designed and built for optimum continuous duty in power utility applications.

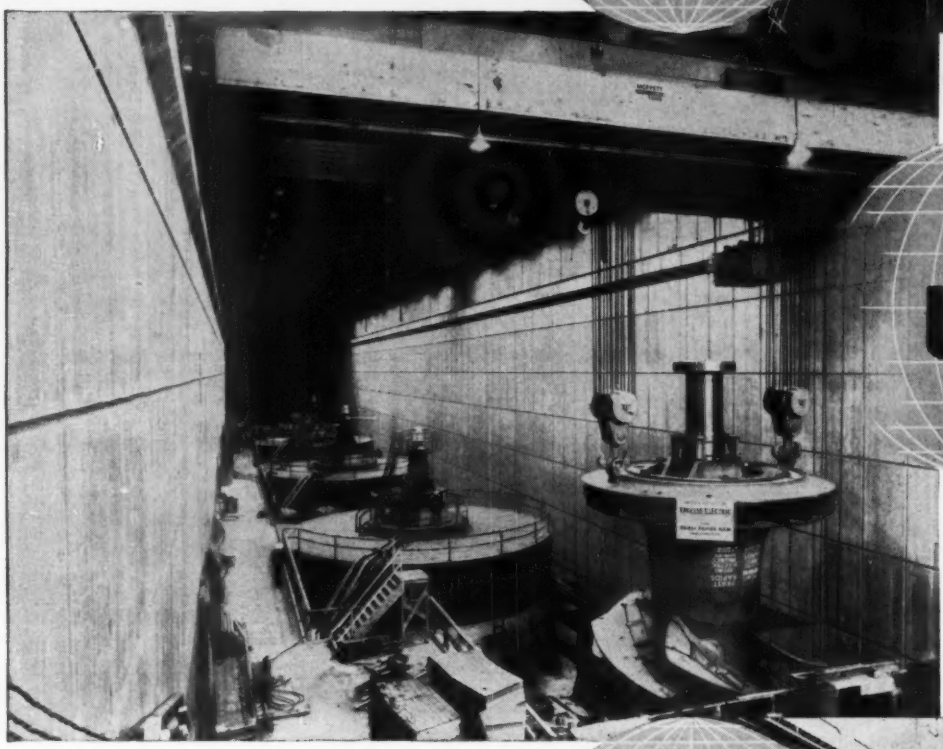
*Write or call today for complete system information.*

**MOTOROLA CC-10** CAPACITOR SWITCHING

Motorola Communications & Electronics, Inc., 4501 Augusta Boulevard, Chicago 51, Illinois • A Subsidiary of Motorola Inc.

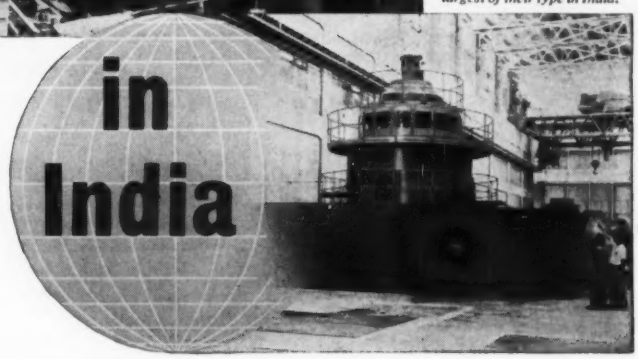
# The world over...

*Salime Power Station—all generating plant, transformers, switchgear and control gear.*




*Priest Rapids Power Station, Washington—ten 114,000 h.p. water turbines and associated 83,000 kVA generating equipment, with five 183,000 kVA, 13·2/230 kV transformers.*

*Hirakud Power Station—two 52,000 h.p. vertical feathering propeller turbines and alternators—the largest of their type in India.*




'ENGLISH ELECTRIC' water turbines and generators have been installed throughout the world. At four major schemes in the United States, 'ENGLISH ELECTRIC' hydro-electric equipment will be adding some 2,352,000 h.p. to America's power potential.

'ENGLISH ELECTRIC' products cover all aspects of the generation, transmission and utilization of electric power. Contracts have been completed and are in course of manufacture for many major American power projects.

# 'ENGLISH ELECTRIC'

*Agents:* ENGLISH ELECTRIC EXPORT & TRADING CO. LTD., 750 THIRD AVENUE, NEW YORK 17, N.Y. Tel: MURRAY HILL 7-0303

*Sub Agents:—*

**James I. Metcalf & Co. Inc.,** Room 704, 1141 Fourth Avenue Building, Seattle 4, Washington. Branch offices in San Francisco, Los Angeles, Portland, Phoenix, for Alaska, Arizona, California, Idaho, Montana, Nebraska, Nevada, Oregon, Utah, Washington, Wyoming.

**Osgood and Associates Inc.,** 988 Spring St., N.W., P.O. Box 7383, Station C, Atlanta Ga., for Alabama, Florida, Georgia, Kentucky, South Carolina and Tennessee.

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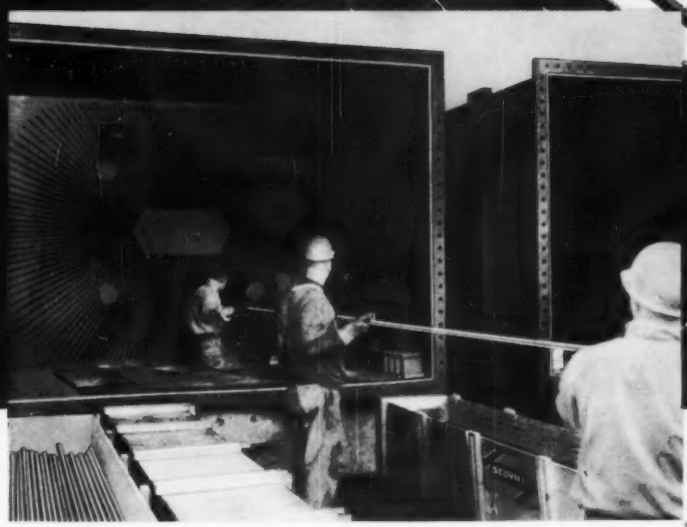
**SERVICE FACILITIES ARE AVAILABLE THROUGH THREE LARGE CANADIAN PLANTS**

OC/US/2A

# YANKEE ATOMIC

trouble-free performance



installing more than 70 miles of

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INHIBITED ADMIRALTY

heat exchanger TUBE

**HEAT EXCHANGER TUBE** for Applications from Marine to Petrochemical, from Compressor Intercoolers to "Cat-Cracker" Exchangers, in these popular Alloys... Phosphorized Admiralty • Admiralty • Arsenical Admiralty • Red Brass, 85% • Deoxidized Copper • Arsenical Copper • Cupro-Nickel, 10%-20%-30% • Aluminum Brass • Aluminum Bronze, 5% • Muntz Metal • Duplex Tube

HIGH RELIABILITY . . . trouble-free performance . . . has become a very specific goal of engineers in the Atomic Age.

This applies whether the problem is reliability of controls in a space vehicle or reliability of the operating equipment in New England's first Atomic Power Plant at Rowe, Massachusetts, being designed by Stone & Webster Engineering Corporation in collaboration with Westinghouse and constructed by Stone & Webster.

Scovill salutes the Yankee Atomic Electric Company's project, where 11 future-minded New England Utilities have set a new milestone in a field of unlimited promise.

Scovill's contribution is HEAT EXCHANGER TUBING . . . mile upon mile of precision-built tube that shoulders a major responsibility for the trouble-free operation of this installation.

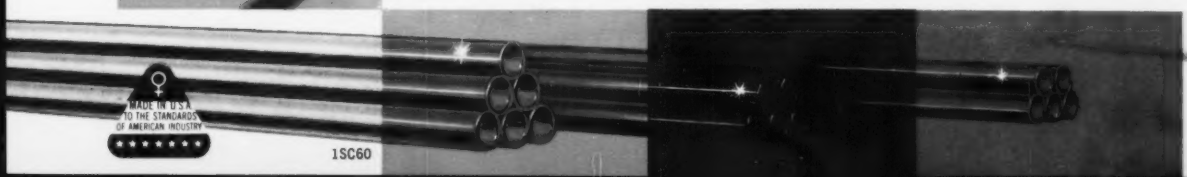
Here are shown being installed some of the more than 12,000, 30-ft. long Scovill Inhibited Admiralty Tubes (⅞" OD X .049" wall) specially made to extremely tight specifications for the main condenser in the Yankee Atomic Electric Company plant... over 70 miles of tube, every foot of which has passed the most rigid inspection.

Here, as elsewhere, Scovill Heat Exchanger Tube alloys and Scovill Technical Services have been recognized as among the finest available . . . to assure trouble-free performance.

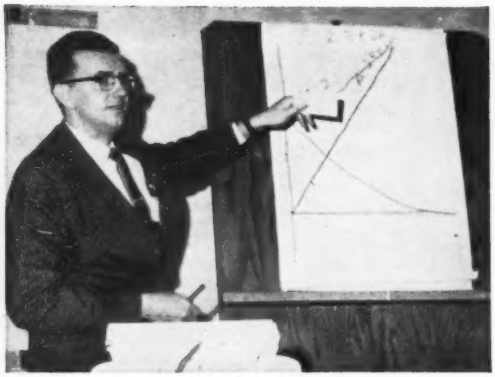
SCOVILL

**SCOVILL MANUFACTURING COMPANY**

Mill Products Division, 99 Mill Street, Waterbury, Connecticut. Phone PLaza 4-1171.




1SC60



# "Rochester Gas & Electric realizes annual savings of $.80 kvar with Secondary Capacitors"

*Harry G. Saddock, Rochester Gas & Electric Co. Rochester, N. Y.

"We have approached the problem of justifying secondary capacitors from several different angles . . .

"An analysis of the economics of secondary capacitors from the standpoint of released capacity showed an annual saving of 50¢ per kvar per year exists at low densities.

"We also considered the secondary capacitor from a loss reduction viewpoint, and have concluded that secondary capacitors nearly pay for themselves from losses alone on 90% p.f. secondaries, and save an additional 50¢ per kvar per year at 80% p.f. Our study indicated that, in both instances, the first unit is the most beneficial . . . so that small-size secondary capacitors scattered uniformly over the system would be the ideal economic solution from the loss reduction standpoint.

"Then, we studied the economics of secondary capacitors from the viewpoint of voltage revenue gain. This study showed that the saving in dollars per kvar of secondary capacitors is about 40¢ per kvar.

"The advent of the meter socket type capacitor has also shown us a way to minimize all the important engineering time in application of our base capacitors. A good percentage of our base kvar may be supplied without sacrificing our diminishing pole space, without costly engineering time, and with a substantial annual savings, besides."

**A reprint of Mr. Saddock's paper, presented at the Second Annual Sangamo Capacitor Seminar, is available on request.*

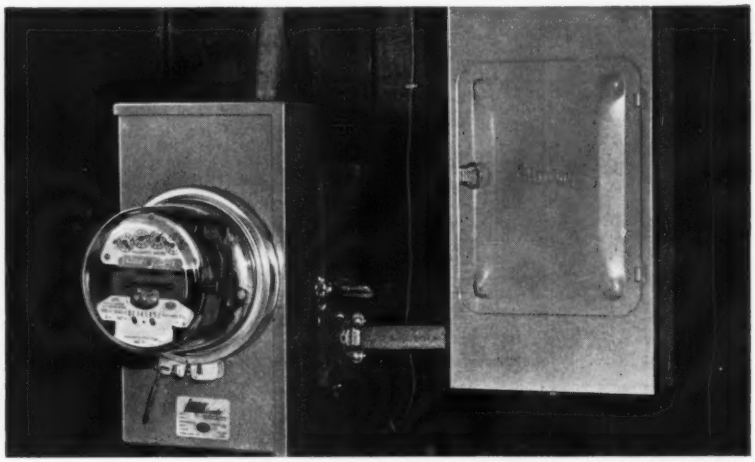
## The Most Economical Secondary Capacitors to Install are Sangamo Secovars

Secovars—240 volt secondary capacitors—are easily installed right at the meter box to relieve the var load all down the line: from the service entrance to the secondaries, to the distribution transformer, to the power transformer, to the generator.

They cut installation costs . . . one-man installation realistically reduces the installed cost per kvar of Secovars in comparison to that of pole-type secondary capacitors. They conserve valuable pole space, too, and eliminate expensive engineering time.

Sangamo's exclusive Secovar Capacitors are available in three types to meet your requirements: Type OS (Original Socket) 2 kvar ratings; Type S, a 2 kvar rating for socket mountings; and Type N, a 1 or 3 kvar rating for nipple mountings. All types are fused, and some models can be furnished with a Klixon thermostatic switch if desired. All three feature weatherproof aluminum housings.

For the whole Secovar story, talk to your Sangamo Representative, or write for Bulletin 1132.



Typical meter socket Secovar Secondary Capacitor installation on the Rochester Gas & Electric Corporation system.

**SANGAMO ELECTRIC COMPANY**

SPRINGFIELD, ILLINOIS

PC60-1

# At Last: A Readable Nuclear Road Map

Two major events have occurred since Electrical World published its last nuclear power report in June of 1959.

First, a credible, readable road map for the civilian nuclear power development of the next decade has been drawn. The mapmaker is the Atomic Energy Commission, but its 10-year program is the product of a monumental joint study by the best brains in the industry and the national laboratories.

Second, the reality *today* of competitive nuclear power in certain fuel cost areas has been signalled crisply as Southern California Edison Co prepares to build a full-size plant on a purely economic decision.

Since the inception of nuclear power development, there has been no outstanding leadership by any one individual, agency or segment of industry. Despite this lack of unified direction, the frequently divergent efforts by government, manufacturers, consultants and private utilities have moved the art to the brink of financial feasibility in a scant decade.

Our editorial hats are off to the conglomerate group which has brought this about under the circumstances.

The amazing feat has been accomplished without the expenditures of imprudent amounts by any one segment of the participants. No one has been bankrupted, though it may be some time before investment is recovered by some of the manufacturers, and a good many have been weeded out in the process. And public power did not get a strong proprietary interest, despite efforts of some of their legislators.

Electrical World has cried for strong leadership from the private utilities, in the fear that it would otherwise be pre-empted by those who would serve the program to federal power on a platter. Fortunately, it was not pre-empted when the utility companies, participating substantially but piecemeal in the development, did not respond to the challenge to guide the over-all effort.

During the past few years, several manufacturers came forth with strong programs, but these were not accepted wholeheartedly, probably because they were of necessity too narrow for the broad-gauge objectives required.

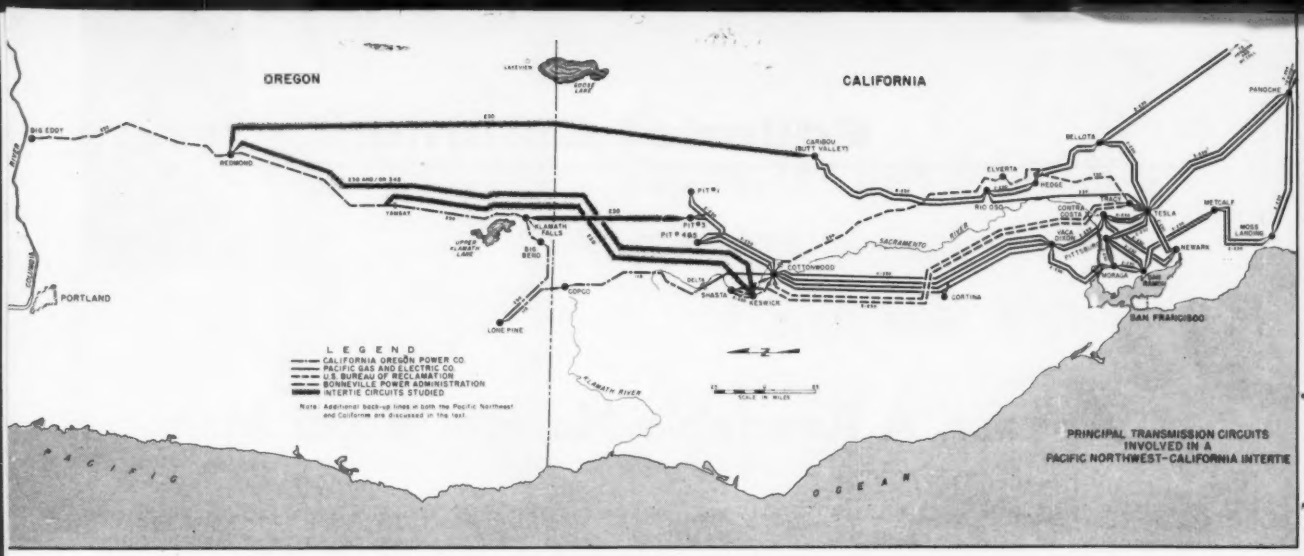
Meanwhile, the AEC, now working more closely with Congress under direction of Mr McCone, set forth, not to impose a rigid program or to favor those who didn't favor themselves, but to chart a plausible course for the next decade based on the experience of the past.

The AEC effort, mounted with the full cooperation of any who would cooperate, has resulted in their map for a unified, constructive, coordinated program of research, development and construction leading to specific and attainable power goals on a sensible timetable.

It comes the closest to providing true leadership as anything we've had yet.

As we stand today on the edge of the AEC's map, we find ourselves, however, at a crossroads. Unless we at least *begin* by following the definitely drawn lines, we can find ourselves shunted off the map on sideroads of political controversy, confusion and waste.

To stay on the map will require the same kind of coordinated cooperative effort that was needed to create it. The challenge and the opportunity are there. Working together from here out, utility industry, atomic industry and government can pass quickly down a common path which can more efficiently extend the gains already realized.




**Bonneville Power Administration marketing area may be defined as . . .**

# Intertie Brings Market Questions

The moratorium on construction of a proposed California-Bonneville Power Administration transmission intertie was continued last week in a one-day hearing by the Senate Interior Committee.

The Committee heard further, exhausting testimony on the proposed 230-kv line to be built jointly by Pacific Gas & Electric Co and California-Oregon Power Co to connect with BPA. But no decision was reached, and the Interior Department was asked again to delay signing a contract with PG&E for the line until the Committee could come to a decision on the matter.

Two points stood out at the hearings: (1) that the Committee would take no action until mid-June, when a study, being prepared for California Gov Edmund Brown, is completed, going into the alternative advantages of the PG&E line or a larger, longer federal line; (2) growing concern among many public power supporters that legislation would be needed to define and block off the Bonneville marketing area to prevent loss of power available to present preference customers in the Pacific Northwest.

Interior Asst Secretary Fred Aandahl testified that his department would not act on the proposed contract until after the mid-June report from California was received, or until after Congress adjourns. He left open the question of whether Interior would go ahead and sign the PG&E contract after Congress closes. Legally, the executive department is not bound by the action of a legislative committee.

Aandahl said his department would be "most responsive" to the Committee's wishes, however he would "not like to specifically answer" on whether he would go ahead with the PG&E contract after adjournment: it would "depend on many conditions."

Sen Henry Jackson (D-Wash.) said he was "not suggesting that this (hearing) go on and on," but he urged Interior to wait on the California report, and for a chance for the affected states to review it.

### PG&E Agrees to Delay

Robert Gerdes, PG&E executive vice president, agreed to the additional delay, pointing out that it would take 1½ years to build his line.

Gerdes said he couldn't understand why the California Municipal Utilities Assn wanted dump power from Bonneville, over the alternative federal line, since there has been a 15-year surplus of dump power in California, and it would be easier for them to take it from the federal Central Valley Project than from Bonneville.

Walter Dreyer, PG&E engineering vice president, commented, "I don't understand why they (California public power supporters) want a high voltage federal line. Bonneville won't give up firm power anyway."

PG&E officials testified they felt the present Bonneville preference customers were already protected from expansion of their market into California, because Bonneville's sale to PG&E at the California-Oregon border would end the preference clause. A power sale to Sacramento Municipal Utility District, over a federal line, would be "something entirely different," he added.

Gerdes stated that PG&E could take only between 1.5-billion and 2-billion kwhr of dump power annually from Bonneville, although up to 10-billion kwhr might be available.

Sen Thomas Kuchel (R-Calif.) agreed "there can be no question that there is an economic waste to the government today" because of unused Bonneville power, but Ken Billington, Washington PUD Assn executive secretary, questioned whether "the urgency being expressed by the proponents (of the private line) in this matter is too important." He said the line should provide for two-way power deliveries.

"As I interpret the Bonneville Act," Kuchel added, "The marketing area . . . is where they market the power." Aandahl refuted this as not applying to "the sale of this kind of (dump) power under the conditions that we are selling it."

# REA Marks Silver Anniversary

**AGRICULTURE SECY BENSON** addresses crowd gathered to observe the 25th Anniversary of the REA

Rural Electrification Administration officials in Washington, D. C., took time off last week to congratulate themselves, and all rural systems, for 25 years of progress since the birth of the rural electrification movement.

It was 25 years ago, May 11, 1935, when President Franklin D. Rooselvelt signed the Rural Electrification Act. This past week, REA officials marked the occasion by speeches, exhibits, a movie, "The REA Story," and the premiere of "The REA Anniversary March," written by Bernard Krug of REA.

Agriculture Secretary Ezra Benson, opening the exhibits, told a gathering of about 100, "electricity freed farmers and their families from endless hours of drudgery . . . electricity has also brought with it the opportunity to build a new kind of rural America . . . Electricity has drawn a large and growing non-farm population to our rural areas.

"The cooperatives have proved an efficient means of getting the power into all parts of rural America," said Benson. "Although they were formed by people who were amateurs in the electric business, it wasn't long before the co-ops were being operated in a business-like manner. Today, the rural electric co-ops can say with pride that there is no better electric service anywhere than that delivered over REA-financed lines. The cooperatives have proved themselves first-class risks.

"In the years ahead," Benson added, "We will see the REA-financed systems make even greater strides toward financial strength."

### 'REA . . . A National Movement'

REA Administrator David Hamil, speaking May 11 in the Commerce Department auditorium, called REA "a national movement of rural people, united in their common need for electric power." He pointed out that once rural electrification had been started, "There was no stopping it."

"Rural people were fed up with promises, with conference, with experiments," said Hamil. "They knew they needed electricity as much, if not more than town and city people.

"Rural people did not want free electricity . . . They asked only for a loan program, and they were willing to pay back their loans with interest . . . They asked that co-ops be permitted to borrow money . . . They asked for the right to build complete electric systems," including generation and transmission facilities. "They felt they should be permitted to serve non-farm consumers as well as farmers."

Hamil added that he felt the rural electrification movement was "as significant to the development of America as the transcontinental railroads."

Sen George Aiken (R-Vt.) called the REA Act "one of the momentous documents ever signed by a President of the United States." He pictured the U. S. of the mid-1930's as desolate, emphasizing "America had to have a miracle and REA was born to meet that need."

Aiken praised each of the REA administrators as "conscientious, efficient and crusading . . . and every one of them had to fight against odds to keep the work going forward.

"Our work is nowhere done," Aiken added. "It will never be done." He pointed to the growth of average annual farm power loads: 600 kwhr in 1935, nearly 4,000 kwhr today, a predicted 10,000 kwhr in 1975. This "shows how far from completion is the work of REA.

"I am glad," said Aiken, "that REA has made it possible for millions of non-farmers to make their homes in rural areas.

"Too many people are satisfied with the status quo today. Too many people fail to realize that it is possible to expand their own businesses without taking it away from others."

**SPEAKERS** at REA Anniversary included Sen George Aiken and REA Administrator David Hamil (right)

# Tornadoes Demolish Oklahoma-Arkansas Towns and Utilities

**CHURCH STEEPLE** survives winds . . .

that demolished Arkansas school . . .

and virtually obliterated parts of several towns near Oklahoma City and Tulsa

Tornadoes which tore through eastern Oklahoma May 5 did an estimated $255,000 damage to electrical systems in the state.

The state's two principal power firms—Public Service Co in Tulsa and Oklahoma Gas and Electric Co in Oklahoma City—reported service was restored by noon the following day to areas able to use power.

PSC reported $180,000 in property damage; OG&E said it suffered a $75,000 loss.

Hardest hit in the Public Service Co system was Wilburton, a city of 2,500 in southeastern Oklahoma. PSC said $120,000 of its damage total was in that city.

The firm rushed 90 men from line construction crews into the area after the storm hit about 6:30 pm. The men worked through the night in a torrential downpour.

At Wilburton, PSC reported, tornadic winds took out poles on a 66-kv transmission line both to the east and to the west, eliminating service to the town's substation.

A twister tore through the center of town destroying roughly a third of the distribution system, including about half of that in the business district.

Some of the town was so destroyed it had no use for electricity, D. J. Tuepker, PSC president said.

The small community of Keota near the Arkansas border lost about half of its distribution system from the same storm, PSC reported.

About 50 men managed to restore near normal service to the half of the distribution system unaffected.

Some 1,000 customers in the rural areas surrounding Vinita in northeast Oklahoma were without power for about 14 hours the night of May 5 when winds tore down poles carrying high voltage transmission lines.

OG&E said nine steel towers were blown down and destroyed outside Oklahoma City and that a 66-kv line between Sapulpa and Drumright was blown down and four frame towers destroyed.

The firm put 100 men into the area to repair the damage and restore service. A mile of 161 kv line was downed four miles east of Bristow. The line runs from Horshoe Lake plant to the riverbank plant in Muskogee.

PSC said its loss was minimized because the equipment at Wilburton and Keota was old and was about to be replaced.

Besides the devastation to property, the storms caused 41 deaths and some 550 injuries over the eight-day period. In the Oklahoma City tornado of April 28, OG&E had 250 men working night and day replacing 150 poles that were snapped off. About 34 of the poles carried high voltage lines. Service was finally restored after 22 hours.

# A&FP-Mexico Deal Reaction Mixed

**Nationalization implications bother some Mexican businessmen, who believe government should sell industries back to private investors after they achieve soundness**

MEXICO CITY—(*McGraw-Hill World News*)—Words of praise and words of bitter criticism were heard in the wake of the Mexican government's spectacular outright purchase of American & Foreign Power Co's Mexican subsidiary, Impulsora de Empresas Electricas, an electric power company with 400,000 customers and 350,000 kw capacity.

Perhaps the most bitter opposition to this move, which cost the Mexican government $106-million dollars (including $34-million in company debts assumed), came from the Mexican bankers meeting in Guadalajara. Anibal Iturbide, president of a large Mexican banking chain, said: "the government's role is not to be an impresario." He added that the government had committed a grave error, putting the country on the road to socialism. It should have offered the foreign utility up for sale to private Mexican groups.

### Government Only Buyer?

But, Pedro Velasco, of The National Patrimony Dept back in Mexico City, in an exclusive interview with *World News*, said: "Everyone knows that the government is the last source anyone visits when they want to sell an industrial property . . . actually, it was known that this utility was for sale and no private groups stepped forward."

Iturbide went on to say that the government should not keep augmenting its position as a business operator, it should be selling off properties that it has lifted up to the position to stand on their own feet.

One of the best examples of this case of the government "staying too long" in a basic industry it helped build up is the case of Altos Hornos, the big steel mill. Iturbide and others believe the government has this business running so well and that the steel situation has so much improved that the government could sell its shares in Altos Hornos, make plenty of money and then reinvest that money in new "bottleneck" industries that need government stimulation because private capital is lacking.

Iturbide said, in speaking for all the private banks and industries in Mexico: "that the government is converting itself into an industrial competitor with extraordinary privileges, blocking the development of those sectors which it is supposed to be protecting."

Pedro Velasco, who is now heading a new government post under the National Patrimony Dept (cabinet post), called "New Acquisitions," said "the government has an obligation to intervene when it is for the public benefit," explaining that in A&FP's case, the company could not raise the necessary development capital for expansion and its "paralysis" was endangering whole sectors of the economy, "hundreds of thousands of Mexicans jobs depend on the health of this utility."

Concerning the possible acquisition of the giant Mexlight (Canadian, American and Belgian owned) utility in Mexico City, Velasco said: "the trend is for the government to manage these public utilities . . ."

A&FP will form a new company in Mexico with David H. Matson, president of Impulsora, as its head. The new company will become a financing and investment institution, putting the government's payments into Mexican industries. One of the industries that tops the list for these new investments, according to an A&FP spokesman, is petrochemicals.

Petrochemicals are just getting started in Mexico under the government's tutelage. The government recently announced that PEMEX, the national oil monopoly would have complete domain over a listed 16 basic petrochemicals products. A&FP's new investment bank will probably put money into PEMEX and other petrochemicals ventures.

When asked if it wasn't strange for an electric power company to suddenly switch into an investment organization with such things as petrochemicals on its list—the answer from an A&FP official here was: "We feel we ought to be able to make a much better profit in petrochemicals, steel and other basic industries in Mexico than we can continuing in the electric power business."

It was explained that, whereas the Mexican government bought the company on a straight business arrangement—a far cry from the days of oil expropriation—the company had been pressured in recent years into a squeeze for more wage hikes without the necessary rate increases. "We got into the position where we could not get money for expansion of production facilities—under the circumstances, no banks would give us the money."

It will also go into the steel industry with its capital, a company spokesman said, adding that there were "no limits" to the investment possibilities.

## Cities Join Forces for Atomic Plant Prototype

An Atomic Energy Commission decision is expected by July on the proposed 50,000-kw nuclear power plant to be built by Los Angeles Dept of Water & Power, Pasadena Municipal Light & Power Dept and the AEC.

The total project cost would be about $20-million, with AEC spending $10-million for the reactor and the two utilities $5-million apiece on generating equipment and the site. Condemnation proceedings have already been filed by the utilities on a 1,170-acre site in San Francisquito Canyon, five miles north of Saugus.

Viewed as a prototype, the project is expected to give experience in constructing and operating a future nuclear power plant involving units as large as 300,000 kw. The type of reactor contemplated is known as the "improved cycle prototype boiling water reactor."

# Cost of New Line Cut by Tests

Experience gained with the high-voltage test line at two-mile high Leadville, Colo., will be put into use soon by Public Service Co of Colorado on the first 16 miles of new 230-kv line running between Cameo Station near Grand Junction and Hopkins.

Hopkins is about eight miles southeast of Glenwood Springs, Colo.

Construction of the new line will begin this summer. Initially, it will be operated at 115 kv. The first 16 miles of the 68-mile line runs at altitudes ranging from 5,900 to 8,625 feet.

PS of Colorado and five manufacturers began experimenting in 1956 on a 1½-mile test line at Leadville to prove that less expensive conductor could be used at high altitudes than had been recommended. Tests were directed toward economically minimizing corona losses and radio interference.

#### Conductor Oversized Before Test

Studies prior to the Leadville line tests recommended one-inch conductor for 230-kv at sea level. For altitudes up to 5,500 feet a 1.108-inch dia. conductor was recommended; this was increased to 1.4-1.6 inches for altitudes up to 10,000 feet.

The Leadville tests established that a 1.213-inch dia. line can be operated as 230-kv with minimum corona loss and radio interference.

Under two recognized methods for figuring conductor sizes, according to PS of Colorado, the first 16 miles of line would have cost $161,420 under the first and $138,170 under the second. The 1.213-inch line will cost $102,260. This amounts to a saving of $35,910, or a cost reduction of nearly 26%.

## TVA Rates May be Raised Because of Bond Interest

The possibility of higher TVA power rates, due to future revenue bond interest payments, was raised in March testimony before the House Appropriations Subcommittee on Public Works, just made public.

Arnold Jones, TVA director, testified that he hoped present rates could be held in line, but "we are constantly studying the question. As you well know, interest rates as of today are higher than they have been."

Jones added, "If we can, by intelligent buying, by economical construction, and by good operation, control our costs, we can accommodate the current interest rates. Certainly in issuing the bonds we have every intention to charge (power) rates that will be adequate. We hope adjustment will not be necessary."

Present TVA plans are to sell about $115-million in revenue bonds during fiscal year 1961 (ending June 30, 1961). Bonds probably would be marketed in two equal lots, the first issue to be sold competitively this coming fall. Jones added that TVA won't sell any bonds until it has exhausted its power revenues.

## Budget Cut on Trinity After Utility Proposal

The Reclamation Bureau made a $2 million cut in its fiscal 1961 budget request for Trinity Division transmission lines after Pacific Gas & Electric offered to wheel Trinity power south of Keswick. House appropration hearings released last week show that the Bureau dropped $2.4 million for construction south of Keswick and asked $320,000 instead for cost studies to permit evaluation of the PG&E proposal when the utility determines the wheeling charges it can offer.

In western Iowa, Bureau officials told committee members that objections of farmers had held up construction of two 161-kv lines for which money had been appropriated last year. The farmers opposed lines running across their valuable tilled fields and wanted the poles set on section lines instead. Utilities in Iowa have many times been forced to follow that pattern, Reclamation witnesses said. But both they and Rep Ben F. Jensen (R-Iowa), of the committee, expressed hope that the landowners would change their opinion when they learn that lines on the square with guyed corner poles will encroach on their fields more than straight lines with poles spaced to fit the farm layout.

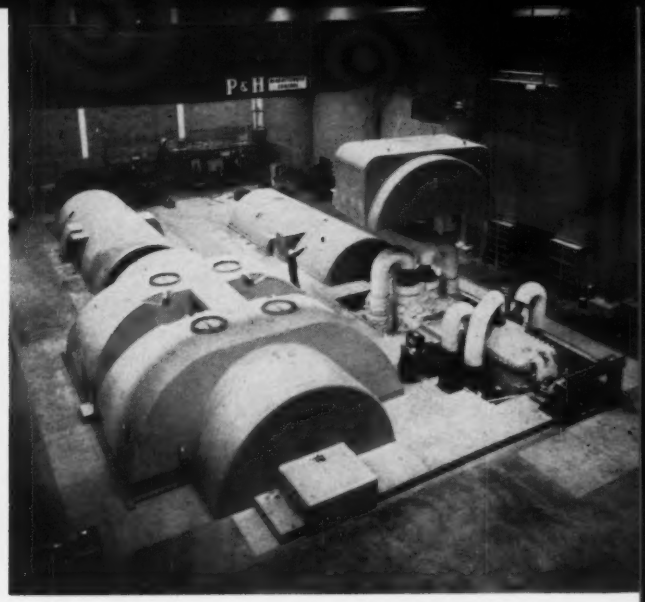
# AIEE Lamme Medal Award Will Go to Lee Kilgore

"Meritorious Achievements in the design of electrical machinery; more specifically, for analyses of synchronous machine reactances; for invention of special armature windings; and for inventions and designs related to large adjustable speed alternating current motors." This is the citation accompanying the Lamme Medal award of the American Institute of Electrical Engineers which will be presented to Lee A. Kilgore at the Summer General Meeting in Atlantic City June 20.

Lee Kilgore is manager of engineering for the Westinghouse Electric Corp, East Pittsburgh Div. He has been with Westinghouse since 1927, and is noted for many achievements in the industry.

In 1934 he designed a 165,000-kw, four-pole generator for Philadelphia Electric Co, and for 18 years it had the highest rating. He was made section manager of the Westinghouse Large Motor Design Section in 1938, assistant manager of the Generator Engineering Dept after that, and then in 1954 was promoted to his present position.

**LARGE EXTRACTION PIPING** was brought out between turbine-generator foundation and the turbine-room floor




**OPERATING FLOOR** in turbine room was raised 4 ft for new 250-Mw cross-compound center-line-at-floor-level unit

# Unit Has Center Line at Floor

## Wisconsin station's Unit 5 has new design for turbine generator for saving turbine-room space requirements

**C. D. WILSON,** Chief Turbine Design Engineer, Steam Turbine Department, Allis-Chalmers Mfg Co, Milwaukee, Wis.

A new design in turbine generator units was introduced when Wisconsin Electric Power Co installed Unit 5 at its Oak Creek Station. Center line of the unit is at floor level, thus increasing by 4 ft the below-floor space for extraction pipes, crossunders, oil pipes, and oil-pipe shielding. The arrangement eliminates some piping.

The center-line-at-floor-level design promises to become as popular as the close-coupled cross-compound design introduced by Allis-Chalmers in the first four units.

Unit 5, a cross-compound machine, has a rated capacity of 275 Mw. It is designed for throttle steam at 2,400 psig and 1,050F with reheat to 1,000F. Exhaust pressure is ½ in. Hg absolute. The extremely low exhaust pressure requires a large exhaust for efficient handling of the large volume of steam flow. Accordingly, an 1,800-rpm, double-flow, low-pressure turbine with two rows of 46-in. exhaust blades was used.

To reduce floor-space requirements in the turbine room, Unit 5 is of the close-coupled, cross-compound design pioneered in the first four Oak Creek units. Both shaft systems are on a single foundation and close together, making a compact, economical installation. The smaller turbine room reduces the basement space for auxiliary equipment. Thus, to obtain more useful space for auxiliary equipment, the center-line-at-floor concept was developed.

The way in which the operating floor in the turbine room was raised for the center-line-at-floor-level design is illustrated in Fig. 2. By this relatively simple change basement space has been increased by 4 ft over the entire floor area of the turbine room. The change offers many advantages in the design of the turbine generator unit, in its supporting foundation, and in the installation of auxiliary equipment.

Stairs and railings have been eliminated, so that all parts of the unit are easily accessible. The higher floor serves as a permanent scaffold useful for easy access to the dismantled unit during maintenance and inspection. There is a minimum of sheet metal lagging to remove when the turbine is serviced, and the metal enclosures over the two high-temperature turbines and exciters are unitized covers easily installed in one piece.

The higher floor raises the below-floor steam chest and reheat control valves, thus reducing the length of high-temperature alloy steel piping between turbine and boiler. The turbine and generator oil piping is out of sight, below the operating floor but above the load-carrying portion of the foundation. No sleeves or deep trenches are required in the structural members of the foundation so that the foundation design is simplified and not weakened by interruptions in the reinforcing steel.

Full advantage has been taken of the high-floor line by providing concrete walls above the supporting members of the foundation to form concrete shielding for the oil piping. This has resulted in an arrangement in which the oil piping is fully shielded from the high-temperature parts of the turbine and, at the same time, accessible for easy installation and inspection.

An added advantage in locating oil piping in this way is that most of the piping does not occupy space

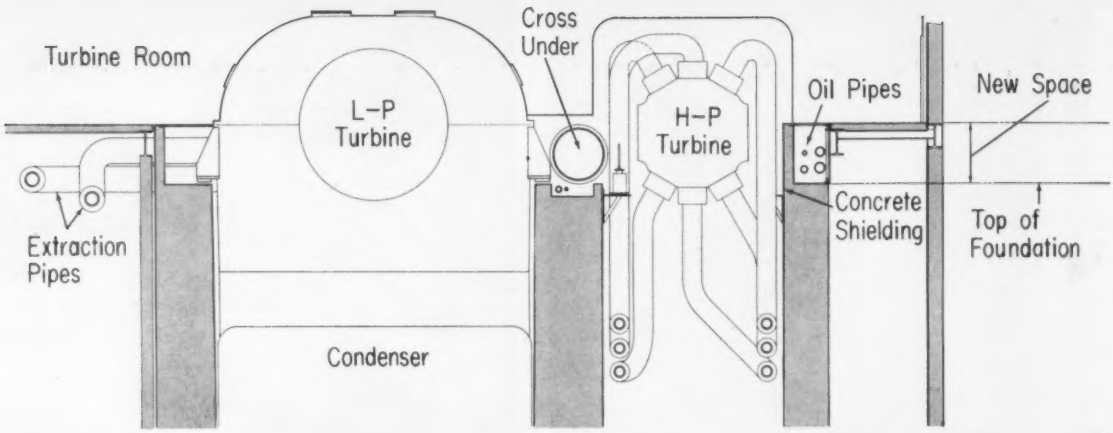



**FIG 1—CENTER-LINE-AT-FLOOR-LEVEL DESIGN** puts foundation top 4 ft below floor, allowing new space for extraction pipes, crossunders, oil pipes and their shielding. Condenser and crane elevations remain unchanged

beyond the limits of the turbine foundation. Space away from the steam turbine-generator unit can be better used for station piping, conduits, and auxiliary equipment.

Space between the top of the foundation and the bottom of the adjoining floor structure has been used to bring out most of the large extraction piping from the turbine. Bringing these pipes out over the top of the foundation relieved the congestion of piping and equipment in the basement area below the turbine. Openings that would otherwise be required in the reinforced foundation walls are eliminated.

The large crossunder steam piping between the high-speed and low-speed turbines is permanently connected to the lower halves of the turbine casings and normally does not have to be removed. These pipes are above the load-carrying portion of the foundation and out of sight from below the passageway between the turbines. They are short and direct. Thermal expansions in the crossunders and turbine are easily accommodated by their dog-leg design in conjunction with stainless steel linked expansion joints.

An ideal arrangement has been developed for removal of the generator rotors. Shallow pits with removable floor sections are provided at the outboard ends of the unit. Rotor-removal gear, permanently installed in each is available when the pits are uncovered.

The center-line-at-floor-level design offers interesting possibilities for application on other types of machines. One, now in the design stage, is for a nuclear turbine where maximum shielding from possible radiation effects is desired. The higher floor elevation makes it possible to provide heavy shielding in the floor. Steam valves and piping would be below the floor, connected only to the turbine's underside. All of the turbine, except the upper structures, would be well shielded.

On outdoor units, where very low foundations are desired, the center-line-at-floor-level design solves the problem of obtaining space below the outdoor deck for piping and station equipment. Raising the floor level does not raise the elevation of the crane hook for dismantling the unit. Thus a correspondingly lower and more stable gantry crane can be used.

The design applied to an outdoor installation, reduces the size and weight of weathertight housing.

**FIG 3 — RAISED-FLOOR DESIGN** both minimizes and simplifies the metal housing on station outdoor equipment

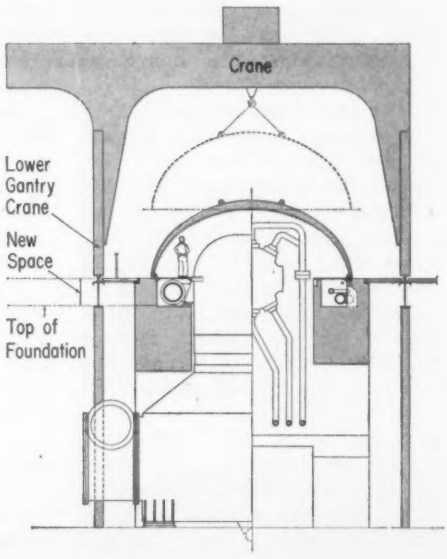
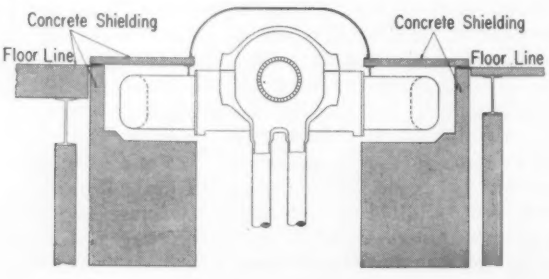



**FIG 2—HIGHER FLOOR ELEVATION** for nuclear plant turbine would permit heavy concrete shielding in floor



A Special Report

# 5TH NUCLEAR POWER REPORT

DAN BRAYMER, Senior Editor

● Today, most of the implements necessary for the early development of competitive nuclear power have already been built, are now building, or being planned. The Atomic Energy Commission has drawn its 10-year plan for research and development. Many of the essential reactor experiments and experimental reactor facilities already exist. And 18 prototype power plants will be operating between now and the mid-1960's.

From these "nuclear tools" will come the new design data and the operating experience that will improve, perfect and refine today's early nuclear apparatus. To the operating experiences of the next few years, whether good and bad, we must look for the new knowledge that will put nuclear power on target by the end of the decade of the Sixties.

As we enter this new phase of exploration and development it is needful that there be a clear picture of the present status of civilian nuclear power facilities, now operating or projected and that the relation of these projects to each other and to the over-all pattern of development of nuclear power.

It is to the presentation of such a picture of the status and prospects of nuclear power projects that this report and these articles are dedicated.

**AEC Maps Nuclear Power Research**.....**page 64**
**Eight Power Reactors Show Promise**.....**page 66**
**Statistics of Civilian Power Projects**.....**page 76**
**Map of U.S. Nuclear Power Projects**.....**page 82**

# AEC Maps Research Plan to Make

## Study weighs status of today's nuclear technology, lays out needed 10-year pattern of development and construction

A 10-year program designed to make nuclear energy from large nuclear power plants economically competitive with conventional plants in high fuel cost areas of the U.S. has been charted by the Atomic Energy Commission. In brief the program calls for the expenditure between 1961 and 1969 of an average of about $200 million a year. And, as presented to Congress by Chairman McCone, it contemplates allocation of about $700 million for research and development on specific concepts, including some six forseeable reactor experiments; $365 million for at least 14 prototype reactor power plants, and $645 million for general engineering support of the civilian power reactor program.

The program is the product of a massive study of the status and prospects of nuclear technology and economics, undertaken by the Commission's Reactor Development Division in June 1959. It lays out in detail the pattern and time table for research, development, and reactor construction required to achieve the two fundamental objectives of its civilian power program:

- Reduce the cost of nuclear power to levels competitive with power from fossil fuels in high energy cost areas of the U.S. within 10 years.
- Support a continuing long range program to further reduce the cost of nuclear power in order to increase the economic benefits and extend these benefits to wider areas.

The first of these objectives was further defined as follows:

**1.** The ten-year period is measured from 1958, when AEC's objective was first stated.

**2.** Competitive nuclear power is considered to be achieved when utility executives can decide to build nuclear plants on economic grounds.

**3.** High cost energy areas are defined as areas where fossil fuels cost 35 cents per million Btu or higher. Conventional power costs in these areas are estimated to be about 7 mills per kw hr for a 300-Mw single-unit station operating at an 80% load factor with 14% fixed charge rate on an estimated net capital cost of $166 per kw.

### According to AEC's 10-Year Program of Civilian Power Reactor Development . . .

| | Pressurized Water | Boiling Water | Organic Cooled | Sodium Graphite | Enriched Gas Cooled | Fast Breeder | Aqueous Homogeneous | Heavy Water |
|---|---|---|---|---|---|---|---|---|
| **By Investing These Millions in Nuclear Research and Development Between Now and 1970[1] . . .** | | | | | | | | |
| Research & Development | $27[3] | $59 | $72 | $84 | $107 | $143 | $79 | $90 |
| Construction Cost—Gross | 126[3] | 136 | 104 | 165 | 121 | 179 | 99 | 193 |
| Construction Cost—Net[2] | 65 | 66 | 38 | 99 | 52 | 101 | 74 | 106 |
| Total—Gross | 153[3] | 195 | 176 | 249 | 228 | 322 | 178 | 283 |
| Total Net[2] | 92 | 125 | 110 | 183 | 159 | 244 | 153 | 196 |
| **. . . These Nuclear Energy Costs for 300-Mw Plants Built Today . . .** | | | | | | | | |
| Capital Cost, million | $73.4 | $78.9 | $66 | $90.9 | — | $76.5 | $96.9 | $108 |
| per Kw | $244 | $263 | $220 | $303 | — | $255 | $323 | $360 |
| Energy Cost, Mills per Kwhr | | | | | | | | |
| Fixed Charges | 5.05 | 5.26 | 4.39 | 6.11 | 5.97 | 5.10 | — | 7.05 |
| Fuel Cycle Costs | 3.38 | 3.47 | 5.72 | 4.12 | 3.21 | 7.10 | — | 4.22 |
| Operating & Maintenance | 0.59 | 0.61 | 1.09 | 0.70 | 0.89 | 0.79 | — | 0.91 |
| Insurance | 0.26 | 0.27 | 0.25 | 0.29 | 0.29 | 0.26 | — | 0.32 |
| Total | 9.28 | 9.61 | 11.45 | 11.22 | 10.36 | 13.25 | | 12.50 |
| **. . . May Be Reduced to These Values for Tomorrow's Plants by the Dates Shown** | | | | | | | | |
| Capital Cost, Million | $64.0 | $64.5(58.6)[4] | $53.2 | $67.2 | — | $66.5 | — | $80 |
| per Kw | $213 | $215 (195) | $177 | $224 | — | $222 | — | $267 |
| Energy Cost, Mills per Kwhr | | | | | | | | |
| Fixed Charges | 4.40 | 4.31(3.91)[4] | 3.53 | 4.47 | 4.63 | 4.43 | 6.38 | 5.80 |
| Fuel Cycle Costs | 2.56 | 2.29(1.96) | 1.83 | 2.0 | 2.62 | 1.99 | 2.12 | 1.21 |
| Operating & Maintenance | 0.59 | 0.61(0.61) | 1.09 | 0.65 | 0.49 | 0.79 | 2.53 | 0.91 |
| Insurance | 0.25 | 0.24(0.23) | 0.22 | 0.25 | 0.24 | 0.25 | 0.30 | 0.28 |
| Total | 7.8 | 7.45(6.71) | 6.67 | 7.42 | 7.98 | 7.46 | 11.33 | 8.20 |
| Energy Costs Achieved by | 4/66 | 6/67 6/67 | 1/67 | 1/68 | 12/68 | 1/69 | 1/70 | 1/69 |

[1] Includes R&D and construction funds supplied by private industry in cooperative arrangement with the AEC but does not include any private industry cost in non-cooperative arrangement with AEC

[2] Net construction investment includes the cost for test and experimental facilities plus the additional cost for prototype and larger power plants which is over and above costs of conventional plants of the same size.

[3] Does not include estimate funds of $125 million for R&D or $5 million construction cost for Shippingport

[4] Figures in parenthesis are for nuclear superheat plants

# Nuclear Power Compete by 1968

Primary emphasis in the program was concentrated on large power reactors of 300 Mw because it is in the large sizes that nuclear plants will most easily and quickly prove economic.

All eight major reactor concepts that are currently being developed were evaluated on a comparable basis to determine present and future technical and economic potential. These included: Pressurized water, boiling water, sodium graphite, organic-cooled, fast breeder, heavy water-natural uranium, enriched gas cooled, and aqueous homogeneous types.

The essence of AEC's evaluation of the present and future economic potential of these eight major reactor types is summarized on the accompanying table. These data show that energy from 300-Mw reactor power plants built with today's technology would cost 9 to 13 mills.

AEC also found that it could project ahead to 1968, and beyond, the development and construction projects and financial cost that would be required to bring energy costs from certain reactor plants down between 7 and 8½ mills per kwhr by 1968. At these costs nuclear power plants could become economically competitive with conventional plants using fuel costing 35 to 40 cents per million Btu.

The study also shows that the pressurized water reactor could compete with conventional plants at an earlier date than any of the other reactor types. However, it is also evident that light-water systems, with nuclear superheat, and the organic system are essentially equal from the standpoint of power cost, the date when the potential can be achieved, and development cost required to reach the goal.

At the 1960 Nuclear Congress in April, Frank Pittman, Director, and U. M. Staebler, Senior Assistant Director, of AEC's Division of Reactor Development added the prospects up this way:

"We have come to the conclusion that it will be possible to achieve economic nuclear power in high cost areas of the U. S. by 1968 with continued aggressive development of light water-cooled and organically-cooled reactors. While either of these systems appears to be capable of achieving the objective, the potentialities in either line of development are such that selection of one to the exclusion of the other does not appear justified."

They went on to point out that: "The number of potential areas of improvement still unexplored warrant a belief that one or both these systems can be expected to be improved beyond the potentialities presently forseen and that they will be serious contenders also in the long range power picture."

However, authors of AEC's program carefully reported that reactor manufacturers claim 300-Mw boiling water or pressurized water power plants can be built today, on a fixed price basis—with certain fuel cost guarantees—which may produce energy at a cost that should be competitive *over their life* with power from conventional plants located in high fuel cost areas.

### 360 Mw Plan to be Built

A scant three months after AEC presented its program, Southern California Edison Co announced, on April 26, its intent to start construction in 1961 on such a plant; a pressurized-water reactor power plant having an electrical capacity of 360 Mw. The $70 million project will take four years to complete, will be completely privately financed. The reactor system is based on a concept introduced by Westinghouse that is expected to produce energy at 7.3 mills per kwhr (EW Oct 5, 1959 p 94).

At least two other utilities are considering plants of a similar size, but have not yet made firm commitments or selected a preferred reactor type. Directors of the New England Electric System have authorized construction of a 200 to 300 Mw nuclear power plant for operation about 1966 or 1967. Pacific Gas & Electric, in addition to its Humboldt Bay boiling water reactor prototype plant, is considering manufacturers proposals for a 300 Mw reactor and is hopeful that a decision can be made soon.

Today as AEC's 10 year development, program is being launched, there are already 18 prototype civilian power reactor plants under construction or development. Together, they involve industry and government committments of more than $734 million divided about $478 million by industry and $256 million by government. Another $300 million is involved in committments on other civilian reactor projects.

### Utility-Sponsored Program

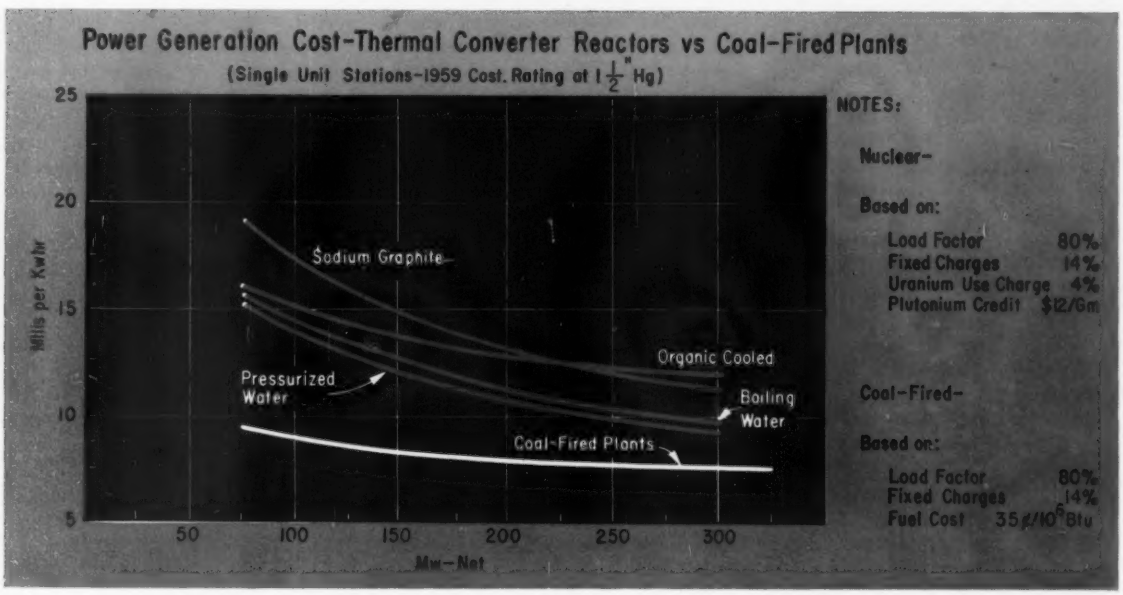
The nation's electric utility companies are today heavily committed to a broad and diversified program for the development of economically competitive nuclear power, much of it in cooperation with the AEC. Four nuclear power plants are now in operation which were built either wholly or in part with utility company funds. Two more, are almost ready to go into operation, will bring atomic power plant capacity to some 490,000 kw by the end of the year. Another nine—including the newly announced Southern California project—are either under construction, in design or are under contract. Two other plants although authorized are not yet formally under contract. These 17 projects will provide 1,800,000 kw of nuclear capacity, when completed and will involve utility expenditures of some $650 million.

In addition, nuclear power projects are now under construction on the systems of three publically owned utilities; Consumers Public Power District of Nebraska, the City of Piqua, Ohio, and the Puerto Rico Water Resources Authority. AEC will shortly select a municipal or rural cooperative system on which to locate a small (22 Mw) sized pressurized-water prototype power plant, authorized last year. Two proposals are now in from publicly owned utilities to supply facilities for a 50-Mw improved-cycle boiling water prototype power plant.

• The following pages of this report present a review of the status of these civilian power reactor projects. Their role in the development of economically competitive nuclear power is discussed in relationship to future reactor experiments and prototype power plants that may be built as part of AEC's 10-year plan.

## How Civilian Power Reactor Projects Are Classified

| Civilian Power Reactor Projects | Reactor Type | Reactor Class |
|---|---|---|
| Shippingport<br>Yankee Atomic Electric<br>Indian Point<br>Saxton Nuclear Experiment<br>Small Power Reactor<br>Southern California Edison 360-Mw Plant | I — Light Water Cooled Reactor<br>→ A — Pressurized Water Reactors | Thermal Converter |
| BORAX — 5<br>Experimental Boiling Water Reactor (EBWR)<br>Vallecitos Boiling Water Reactor (VBWR)<br>Humboldt Bay<br>Elk River Plant<br>Dresden Nuclear Power Station<br>Big Rock Point Plant<br>Improved Cycle Boiling Water Reactor | → B — Boiling-Water Reactors | |
| | C — Nuclear Superheat Reactors<br>1. Pressurized Water<br>2. Boiling Water | |
| Pathfinder (No. States Power)<br>Puerto Rico Reactor (BONUS) | → | |
| Organic Moderated Reactor Experiment (OMRE)<br>Experimental Organic Cooled Reactor (EOCR)<br>Piqua Organic Moderated Reactor<br>Organic-Cooled Reactor Prototype | → II — Organic-Cooled Reactors | |
| Experimental Gas-Cooled Reactor<br>Peach Bottom Atomic Power Station (HTGCR) | → III — Enriched Gas-Cooled Reactors | |
| Sodium Reactor Experiment (SRE)<br>Hallum Nuclear Power Facility | IV — Sodium-Cooled Reactors<br>→ A — Sodium-Graphite Thermal Reactors | |
| Experimental Breeder Reactor — I (EBR-1)<br>Experimental Breeder Reactor — II (EBR-2)<br>Enrico Fermi Fast Reactor Plant | → B — Sodium-Cooled Fast Reactors | → Fast Breeder |
| Plutonium Recycle Test Reactor<br>Heavy Water Components Test Reactor<br>East Central & Florida West Coast Plant<br>Carolinas-Virginia Nuclear Power Station | → V — Heavy Water Reactors | Natural Uranium and Recycle Reactors |
| Homogeneous Reactor Experiment (HRE) | → VI — Aqueous Homogeneous Reactor | → Thermal Breeder |




**AMONG THERMAL CONVERTER REACTORS,** light water-cooled and organic-cooled types appear equally capable of achieving economically competitive costs by 1968, though experience gives pressurized-water a slight edge. Curves show nuclear energy cost for plants based on today's technology. Data is lacking on enriched gas cooled costs

# Eight Power Reactors Show Promise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3. Organic-cooled reactor promises strong competition for other concepts.....p 70

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## 1. Pressurized-Water Reactors

● Economic nuclear power is almost certain to be first produced in this country in light-water reactor plants of the pressurized or boiling water types. Furthermore, in the opinion of AEC, it will not be long before one of the other of these concepts produces competitive power with a 300 Mw unit in one of the high fuel cost areas of the U. S. In fact, since the Commission gave its opinion that construction of light water units of this size may be practical now, a 360 Mw plant has been announced.

Of the two light water concepts the pressurized, rather than the boiling concept, is considered the more technically advanced and the one with which today, experience is more complete. Much of the pressurized water technology, particularly in fuels and materials, has been used to speed progress of other concepts.

To date accumulated PWR operating experience has not only demonstrated the feasibility of this concept but also shown these plants to be safe, dependable and reasonably easy to control.

But for the next four or five years, Commission supported research and development will be concentrated on solving problems of nuclear superheat, extending fuel life, cutting fuel costs, and simplifying fabrication, making containment simpler and cheaper, and generally making construction less costly.

A summary of presently operating and projected pressurized water projects follows.

### Present Pressurized-Water Projects

**Shippingport Atomic Power Station**—The country's first large-scale (60 Mw) nuclear power station is jointly-owned by AEC and the Duquesne Light Co and was built under the Commission's Reactor Development Program. Since completion in 1957 it produced 388,600,000 kwhr (gross) from the first loading of enriched uranium "seed" in its seed-and-blanket core. It was shut down for refueling in October 1959 after operating the equivalent of 5,800 full-power hours. Design life of the first seed was 3,000 hours.

Refueling was completed in April 1960 and full power operation resumed subsequently. The estimated life of this second enriched uranium seed is 7,200 hours at full power or 32,000,000 kwhr (net). It is expected that the station will be operated at a higher load factor during the life of the second seed.

Alterations to Shippingport to increase the output to 150 Mw equivalent are under consideration. Plans are

**What's Ahead for Pressurized-Water Reactors**

**AEC PLANS FOR PRESENT PWR PLANTS**

**Shippingport** (60 Mw) will have its power raised to 150 Mw. The present first core will be replaced by a new high-density flat-plate oxide seed and blanket core. Aim is to demonstrate feasibility of seed and blanket concept.

**Yankee Atomic Plant** (110 Mw) will test stainless clad slightly-enriched uranium dioxide elements and solution poison for shut-down control.

**Indian Point** (163 Mw plus 112 Mw fossil superheat) is expected to produce data on thorium—U235 fuel mixtures and large water-cooled reactor systems.

**Saxton Nuclear Experiment** (4 Mw) is expected to do testing under limited boiling water conditions.

**Small Power Reactor Prototype** (16 Mw plus 6 Mw fossil superheat) will demonstrate economics of small pressurized reactor and bulk boiling.

**AEC's SUGGESTIONS FOR FUTURE PWR PROJECTS**

**Advanced PWR Prototypes** may be justified to demonstrate experience from Shippingport, Yankee and Indian Point. Design could start in 1962 construction in 1963-64.

**Spectral-Shift Prototype** (50-100 Mw) to prove development work in progress on reactor with heavy water added to light water coolant. Initially high concentration of heavy water is reduced as fuel is used to cut neutron diffusion and extend fuel life. May be initiated in early 60s.

**Remote Prototype** (20-30 Mw) would test reliability of small plant in isolated location. May be initiated in 1962.

**AEC Feels Utility Decision** could be taken now on economic grounds to build large PWR plant in high fuel cost area that would be competitive with conventional plant.

being firmed up to install a new core (PWR-2) capable of developing higher performance in terms of power density and lifetime. It will have a thermal capacity 2½ times that of the present core. Since facilities for generation at Shippingport are adequate for 100 Mw, installation of the second core will entail installation of a "heat sink" to condense steam in excess of that required to operate the currently-installed generator.

**Yankee Atomic Electric Plant**—This 110-Mw prototype power plant is being built by Yankee Atomic Electric Co at Rowe, Mass under AEC's Reactor Development Program, at a cost of $50 million. Construction is virtually completed. All major building and the 125-ft containment sphere is finished. Turbine generator and other items of major mechanical equipment, such as main coolant pumps, pressurizer, and four steam generators, are in place. The reactor vessel has been installed and pressure tested. Fuel elements are in storage and initial critical operation this summer is possible with power production later this year.

**Indian Point Nuclear Power Plant** is being financed and built by Consolidated Edison Co of New York, Inc. The 275-Mw (gross) plant, at Buchanan, uses highly-enriched uranium mixed with thorium as fuel. Equivalent gross electrical capacity of the reactor is 163 Mw. It is supplemented by fossil superheater that boosts plant capacity by 112 Mw. At the beginning 1960 construction was 60% complete with operation scheduled for September 1961.

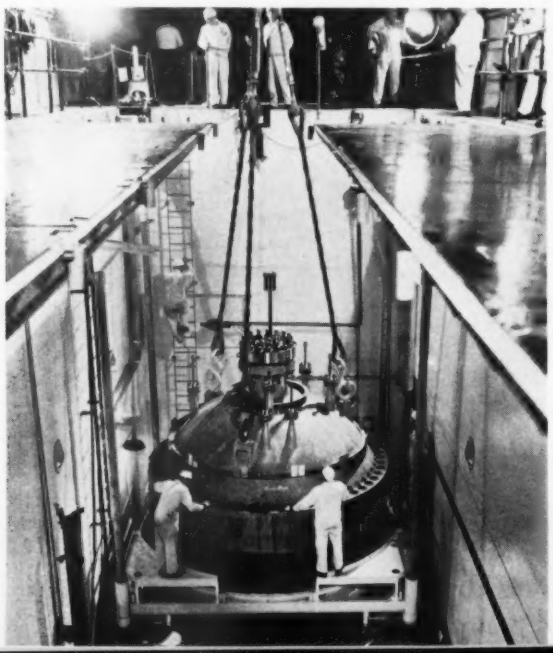
The thermal, nuclear, and mechanical design of the core is complete. First steps in core manufacture have been taken. By mid-May all four steam generators, the pressurizer and reactor vessel are expected at the site. Oil-fired superheaters have been erected and the main turbo-generator is being erected.

**Southern California Edison Co**—A letter of intent to design and build a 360 Mw pressurized water reactor power plant at an undetermined location, has been sent to Westinghouse and Bechtel by Southern California Edison Co. Construction of the $70 million project will begin next year against a 1964 startup target. Energy cost is described as competitive and presumed to be 7.3 mills per kwhr based on previously published information. The project will be privately financed.

# 2. Boiling-Water Reactors

Feasibility of boiling water reactor power plants has already been demonstrated. A number of prototype power plants using the boiling water concept are now in operation or being built. There is every reason to believe that these plants, which include Dresden, Humboldt Bay and Elk River, and which all use boiling reactors of different size and design, will operate entirely successfully. This advanced state of development is due in part to the extensive experience and technology obtained with the pressurized water program and early boiling experiment like BORAX and EBWR.

**50-TON HEAD** is placed on reactor vessel at Dresden Nuclear Power Station prior to the making of steam



Today, manufacturers of boiling water reactors have told AEC that a 300-Mw boiling water plant can be built now which may produce energy competitive with that from conventional plants in certain high cost fuel areas of the U. S.

Construction of such plants by utility companies in high cost areas is currently being considered as a contribution of development of economic power.

Development work and design studies have been underway for some time on nuclear superheat, concentrating chiefly on the superheat fuel element. This could make possible production of steam at temperatures and pressures used in modern conventional plants of high efficiency. The Pathfinder plant in South Dakota and the BONUS plant in Puerto Rico will demonstrate the feasibility of nuclear superheat in cores of different design.

### Status of Present BWR Projects

**Dresden Nuclear Power Station** began producing power April 15. Half-power operation was achieved April 25. Full power operation is predicted for this summer. It is being built by the Commonwealth Edison Co, in cooperation with the Nuclear Power Group. The 180 Mw dual-cycle boiling water reactor plant is privately financed and is being built for a contract price of $45 million. Dresden is the largest all-nuclear power station in the U. S. to date. Plant construction began in 1957 and was essentially completed in September 1959 several months ahead of schedule. Initial criticality was achieved October 15, 1959. The reactor was later shut down to modify control rod drives. Criticality was again achieved March 31, 1960.

**Humboldt Bay Power Plant** located at Eureka, Cal, is a 60-Mw advanced boiling water reactor prototype power plant. The project is scheduled for criticality on July 1, 1962 and it is being developed, built and

**Saxton Nuclear Experiment**—A 4,000 kw experimental reactor facility is to be located at the Saxton, Pa. station of Pennsylvania Electric Co and will be hooked to an existing 12,000 kw unit. A construction permit has been issued and work started. Estimated date of criticality is November 1961. The experiment is independently-financed by the Saxton Experiment Corp formed by subsidiaries of the General Public Utilities Corp. Plans call for 5 years of operation with emphasis on lowering nuclear power costs through increasing fuel-use efficiency.

**Small Power Reactor Project** is to have a 16,500-kw pressurized-water reactor backed-up by a fossil superheater to give a 22,000 kw plant capacity. The project will be carried out under second-round terms of the AEC's Power Demonstration Reactor Program, and has as its objective development of a suitable reactor for producing economical power in a small plant. Five proposals have been received from cooperatives and public power organizations to operate the plant which the AEC is designing and plans to build. The organization selected must provide the plant site, turbo-generator facilities, building and services and operate the plant for AEC. Three of the proposed sites have been rejected the others are being re-considered. Construction is to begin in June. Completion date is 1962.

YANKEE ATOMIC ELECTRIC at Rowe, Mass may soon start loading fuel and achieve critical operation this summer

## What's Ahead for Boiling Water Reactors

### AEC PLANS FOR PRESENT BWR PLANTS

**Experimental Boiling Water Reactor** (5 Mw) power being raised to 100 Mwt. Will demonstrate stability at high power density, test plutonium fuel, and study water chemistry.

**Elk River** (16 Mw plus 6 Mw fossil superheat) will evaluate use of mixed thorium oxide and uranium oxide fuel and intermediate heat exchanger in boiling system.

**Consumers Power Co** (50-75 Mw) high power density plant is to test operation and economics at densities of 60 kw/liter and fuel lifetimes similar to lower densities.

**Improved Cycle Prototype** (50 Mw) will evaluate designs to cut size, complexity and cost.

**BONUS** (16 Mw) in Puerto Rico will test production of nuclear superheat steam in small reactor core.

**BORAX-5** (2 Mw) now building will be converted into integral superheat reactor for stability studies of fuels and coolants.

**Pathfinder Plant** (62 Mw) first with nuclear superheat will test high density core leading to reduced fuel enrichment.

### AEC's SUGGESTION FOR FUTURE BWR PROJECTS

**Small BWR Prototype** (20-30 Mw) needed to initiate a small prototype in 1963-1964, will be influenced by results of Elk River, and Humbolt Bay.

**Integral Superheat Prototype** (100 Mw) depends on confirmation of expected savings with nuclear superheat. Probability will be initiated in 1963. Costs expected to be competitive for large plants by 1968.

**Additional BWR Prototypes** in large sizes are unlikely before 1963-1964 when experience with current installations is available.

**AEC Feels Utility Decision** could be taken now on economic grounds to build large BWR plants in high fuel cost areas that would be competitive with conventional plants.

entirely financed by Pacific Gas & Electric Co. Detailed design, begun in September 1958, involves a unique vapor-suppression containment concept that was proposed to cut the cost of the project. In March 1960 AEC's Advisory Committee on Reactor Safeguards ruled ". . . it has not yet been demonstrated that the vapor suppression concept can be relied upon. . . ." Subsequently PG&E asked for and obtained a delay in its hearing for a construction permit while it completes further tests on the station's containment design. The public hearing on PG&E's construction permit probably will be scheduled in August. Construction now is planned to start in September, and initial operation is scheduled for late 1962.

**Consumers Power Co** has announced intentions to build a 50 Mw direct-cycle high power density forced circulation boiling water reactor for 1962 operation at Big Rock Springs, Mich. The plan is to conduct a 4½-yr research and development program, sponsored by AEC, to explore the areas of high power densities, longer fuel life, and reduced fuel fabrication costs. The possibility exists of an increase to 75,000 kw within this development period. The project has been approved by AEC under its Power Demonstration Reac-

tor Program. Construction will start this spring.

**Elk River Plant**—This 22-Mw boiling water reactor being built by AEC for the Rural Cooperative Power Association is scheduled to go critical in November. The plant is now about 60% completed. Its conventional fired super-heater has been hydrostatically tested but remains to be tied in with the reactor and turbine. The reactor pressure vessel has been on site since February. Work is now being centered on piping, instrumentation, completion of reactor vessel installation and biological shielding. Fuel for Elk River is a combination of uranium and thorium oxide.

**Improved Cycle Boiling Water Reactor**—Early in 1960 AEC invited proposals from publicly and cooperatively owned utilities to construct and operate a boiling water reactor of 50 Mw having an improved steam cycle. The design will seek to eliminate complexities of the dual cycle system without sacrificing its advantages. Proposals to build the plant under terms of the second round of the Power Demonstration Reactor Program are due in May. If none are acceptable AEC intends to proceed with construction itself.

**Pathfinder Plant**—When completed Pathfinder will be the first full-scale nuclear power plant having a nuclear superheater. The 62 Mw (net) plant is scheduled for completion in 1962 and is a joint undertaking of Northern States Power Co and Central Utilities Atomic Power Associates with AEC under terms of the third round of the Power Demonstration Reactor Program. The plant is located near Sioux Falls, S. D. It will generate steam at 525 psi, 825 F. Preparatory work at the site began in 1959. Erection of the containment vessel will start this year.

**Puerto Rico** (BONUS)—This is to be a boiling water reactor prototype power plant using uranium dioxide fuel and producing superheated steam within the reactor core for the generation of 16.3 Mw. It will be located near Rincon, Puerto Rico and will sound-out problems involved in applying nuclear superheat and to develop a small-plant prototype design. The $20 million facility will be built by the AEC in cooperation with the Puerto Rico Water Resources Authority under terms of the second round of the Power Demonstration Reactor Program. Construction is to start this year and to be completed in 1962.

### Present Experimental Boiling Reactors

**Vallecitos Boiling Water Reactor** (VBWR)—Located near Pleasonton, Cal, this 5-Mw pilot plant for Dresden is the first entirely investor-financed nuclear reactor in the world. It was built jointly by Pacific Gas & Electric Co and General Electric Co. Started in 1956 it supplied energy for the PG&E system from 1957 until it was shut down in October 1959 to permit a planned $1 million modification. Modification was completed in April and operational testing begun. The present schedule calls for fuel loading and critical testing to begin in mid-May with power production in June of this year.

**Experimental Boiling Water Reactor** (EBWR) at Argonne National Laboratory has operated since 1956 with a capacity of 4.5 Mw (net). The facility has been out of operation since 1959 and is being modified to bring its thermal rating up from 20 Mwt to as near 100 Mwt as possible. Modification is to be finished in September 1960. However, limited power (40 Mwt) operation can begin this spring.

**BORAX-5** is the fifth in a series of experimental reactors built by AEC at National Reactor Testing Station, Arco, Idaho to demonstrate safety aspects and feasibility of an integral nuclear superheat system. The reactor will have a capacity of 40 Mwt. Construction started in December 1959. Startup is scheduled for October 1960.

## 3. Organic-Cooled Reactors

**What's Ahead for Organic-Cooled Reactors**

AEC's PLANS FOR PRESENT ORGANIC PLANTS

**Organic Moderated Reactor Experiment** (5-15 Mwt) now being modified will continue as fuel test facility.

**Experimental Organic Cooled Reactor** (40 Mwt) being designed. Will permit acceleration of fuel, moderator and coolant tests. Criticality scheduled in 1963.

**City of Piqua Plant** (11 Mw) will analyze potential of organic concept in small plants and, by extrapolation, will provide data for large plants.

**Organic-Cooled Prototype** (50 to 100 Mw) now awaiting industry response will yield data on fuel with aluminum clad uranium oxide. Primarily a large plant prototype.

AEC's SUGGESTIONS FOR FUTURE ORGANIC PLANTS

**Advanced Organic Prototype** (50-100 Mw) will be indicated in mid 1960's to demonstrate improvements coming from research. Costs may justify big plant construction on economic grounds in high-cost area by 1965.

● Although technology of the organic cooled reactor concept is in early stages of development, AEC considers it quite highly probably that organic-cooled reactors can achieve competitive power in high fuel cost areas of the U. S. by the middle 1960's, and over the longer range in other areas.

Experience with this concept, up to now, has been limited to the operation of the Organic Moderated Reactor Experiment (OMRE), and the design of the 11-Mw reactor for the City of Piqua, Ohio.

Simplicity of the system and direct applicability of technology from water reactor programs, makes it believable that the organic-moderated reactor concept can achieve fairly early potential with less R&D and fewer prototype plants than other concepts.

Organic-cooled reactors operate at higher temperatures and lower pressures than water reactors. They have no corrosion problems. These things make for low capital cost. But costs of replacing decomposed coolant are a disadvantage. Coolants also have poor heat transfer characteristics and require longer life fuel.

**Piqua Organic-Moderated Reactor**—The 11.4-Mw Piqua reactor is being built by AEC for the City of

## What Round Is It?

In the early phases of AEC's Power Demonstration Reactor Program three invitations were extended to industry to join with the Commission in financing prototype plants to demonstrate the practicality of various reactor concepts for power generation purposes.

Each invitation was open for a limited time only, and the terms of each called for different degrees of financial participation and ownership of the projected plans.

The three original invitations are now history. But the terms under which they were made have been repeated many times by AEC in subsequent invitations. As a consequence the ownership and financing of many nuclear plants have come to be identified as "first round," or "second round," or "third round" projects depending on the similarity of their contract terms, under the Power Demonstration Reactor Program, to earlier invitations.

The general nature of the terms and the projects identified with them are given below, together with projects that were not built under the PDRP.

**First Round** — A name-your-own-terms invitation.
- Enrico Fermi
- Yankee Atomic Electric

**Second Round** — AEC finances design and construction of the nuclear portion of the project, which it owns. The utility (usually a cooperative or pumblic power organization) contributes a plant site, turbine-generator facilities and associated buildings and purchases steam produced by the reactor from the Commission
- Elk River Plant
- Piqua Organic Moderated Reactor
- Hallam Nuclear Power Facility
- Small Size Nuclear Power Plant
- Puerto Rico Boiling Water Reactor
- Improved-Cycle Prototype Boiling Reactor

**Third Round** — Utility participating (usually a private power company) designs, builds, and operates the entire plant. AEC supports research and development for the project and waives fuel use charges for five years.
- Pathfinder Plant
- Carolinas-Virginia Nuclear Plant
- Peach Bottom Atomic Power Station
- Big Rock Point Boiling Water Reactor
- East Coast & Florida West Coast Nuclear Group
- Organic-Cooled Reactor Prototype

**Privately Financed Reactor Projects** — Entire project costs privately-financed
- Dresden Nuclear Power Station
- Indian Point Aotmic Power Plant
- Humboldt Bay
- Vallecitos Boiling Water Reactor
- Saxton Nuclear Experimental Reactor
- Southern California Edison Co Plant

**Privately-Operated Projects**—AEC owns reactor plant sells steam to utility
- Shippingport Reactor Power Project
- Sodium Reactor Experiment

**Government-Financed Power Reactor Experiments**
- Experimental Boiling-Water Reactor
- Experimental Breeder Reactor-1
- Homogeneous Reactor Experiment-2
- Organic Moderated Reactor Experiment
- Experimental Breeder Reactor-2
- High-Temperature Gas-Cooled Reactor Experiment
- Los Alamos Molten Plutonium Reactor Experiment
- Experimental Prototype Gas-Cooled Reactor
- Plutonium Recycle Test Reactor
- Heavy Water Components Test Reactor
- Experimental Prototype Gas-Cooled Reactor
- Boiling Reactor Experiment-5
- Experimental Organic-Cooled Reactor

Piqua, Ohio, under terms of the second round invitation of the Power Demonstration Reactor Program. Estimated cost of the project tops $16 million. AEC's portion is $12 million for construction, R&D, training, fuel, etc. City of Piqua is providing $4 million for the site and turbine generator equipment. Design of the reactor has been revised to include complete containment of the reactor. Estimated completion date for the project is mid 1962. On April 1 the containment shell was 50% completed.

**Organic-Cooled Reactor Prototype**—Early in 1960 AEC invited privately and publicly-owned utilities to build a 50-Mw prototype organic cooled and moderated reactor power plant under terms of the third round invitation of the Power Demonstration Reactor Program. Proposals submitted under the invitation are due this month. Criticallity target date is 1964.

The proposed prototype plant would operate with forced convection cooling and produce steam at 600 F or higher from the organic coolant. Improved uranium oxide fuel clad with sintered aluminum powder is expected to increase allowable fuel surface temperature, increase fuel burnup and cut the cost of power from the reactor. It is a large plant prototype.

**Organic-Moderated Reactor Experiment** (OMRE)—This reactor experiment at the National Reactor Testing Station has been operating for two years. In this time OMRE has fulfilled its purpose of establishing the feasibility of the organic moderated concept. No serious problems have been uncovered, except for some difficulty with rust particles in the circulating coolant which blocked the coolant inlet passage. Operating started on its second core in 1959. In 1960 design will be finalized on a modification involving fuel handling, buildings, and support facilities with only minor modifications to the reactor vessel itself.

**Experimental Organic-Cooled Reactor** (EOCR)—Because the OMRE lacks the necessary organic loops needed to investigate new coolants and fuel elements a new facility is planned by AEC at National Reactor Testing Station. It will be able to provide power reactor core conditions in full core tests or in loops for investigation of new organic coolants and elements. The reactor will produce about 40 Mwt but there will be no electrical generation. Construction will start this year. It is scheduled to go critical in 1963.

# 4. Enriched Gas-Cooled

● The promise of the enriched gas-cooled reactors lies in the potential they possess to produce superheated steam with a quality like that used in large conventional steam plants. Moreover, because they can operate at low pressure, these reactors can be built in large sizes.

However, the experimental data available on enriched uranium gas-cooled systems is not complete enough to evaluate their economics as reliably as with, say, liquid-metal cooled systems. Nevertheless the potential of these systems is attractive enough to lead the AEC to continue a vigorous research and development program in this area.

What is done in the field of gas-cooled reactors in the future will depend a lot on the extensive research and development now under way or planned in connection with the Experimental Gas Cooled Reactor now being built at Oak Ridge and on the High Temperature Gas Cooled Reactor to be built by Philadelphia Electric Co at Peach Bottom, Pa.

These two reactors take different approaches to the gas-cooled concept. EGCR will use slightly enriched uranium oxide fuel, stainless clad; HTGR will use a graphite-clad fuel comprising a mixture of fully enriched uranium carbide and thorium carbide dispersed in graphite.

### Present Prototype Gas-Cooled Projects

**Peach Bottom Atomic Power Station** (HTGCR)—Philadelphia Electric Co and High Temperature Reactor Development Associates will finance the design and construction of this prototype high-temperature, helium-cooled, graphite-moderated nuclear power plant at Peach Bottom, Pa. AEC will provide $17 million to support post operational research and development and waive fuel use charges under terms of the third round invitation of the Commission's Power Demonstration Program.

Initially the prototype plant will have a plant capacity of 28.5 Mw with its first core and use fuel-moderated elements containing enriched uranium and thorium carbide fuel dispersed in a graphite matrix. Later the stainless clad initial elements will be replaced with

# 5. Sodium-Graphite Thermal Reactors

● Sodium graphite thermal reactor have the potential of achieving economic power in high fuel cost areas. They can be operated at high temperatures and low pressures. But to get full benefit from these characteristics a fuel element is needed that is capable of long life at high temperatures. For this reason, in AEC's view, it is unlikely that the potential of sodium-cooled thermal reactors will be achieved as soon, for example, as sodium-cooled fast breeder plants.

The only sodium graphite reactor currently under construction is the Hallam nuclear power facility. This plant will incorporate U-Mo fuel for the first core loading, a canned moderator, and components known to be complex and expensive.

It is unlikely that work on sodium cooled thermal reactors will be expanded until operating results are in from the Hallam facility.

### Status of Sodium-Graphite Reactor Projects

**Hallam (Neb) Power Facility**—This 75Mw sodium-graphite moderated reactor is being built under the second round of AEC's Power Demonstration Reactor Program. It will be owned by AEC and operated by Consumers Public Power District in conjunction with its conventional 100-Mw Sheldon steam power plant, also now under construction. Hallam is expected to provide design, construction, and operating experience with a prototype sodium-cooled thermal reactor of a type suitable for large central stations. It is scheduled for test in late 1961 and to produce power in 1962. Construction began in April 1959 and is about on time. Sheldon Station will be in operation in April 1961.

**Sodium Reactor Experiment** (SRE)—This experimental facility at Santa Susana, Cal. is part of AEC's reactor development program and is being operated for AEC by Atomics International. Southern California Edison Co installed and is operating the steam electric plant associated with the reactor. Since going into service in 1957 the steam electric plant has been on the line 3,322 hours and has generated 15,331,050 kw hr. A new fuel loading of theorium-uranium alloy has been fabricated and it is planned to operate the SRE with the new fuel within the next several weeks. Accent is on development of uranium carbide fuel which is expected to combine good thermal conductivity with good radiation and thermal stability of ceramic fuels.

### What's Ahead for Sodium-Graphite Reactors

AEC PLANS FOR PRESENT SODIUM-GRAPHITE PROJECTS

**Sodium Reactor Experiment** (6 Mw) for the next several years will be used to test advanced fuels in support of the Hallam plant. It may eventually become a high temperature fuel test facility or be used to demonstrate the feasibility of improvements in thermal sodium cooled systems.

**Hallam Nuclear Power Facility** (75 Mw) will test and evaluate fuels that promise lower fuel cycle cost. Experience will provide data on sodium cooled reactors that are operating with neutrons in the fast and intermediate energy spectrums.

AEC's PLANS FOR FUTURE SODIUM-GRAPHITE PROJECTS

**Advanced Sodium Graphite Prototype** (75 Mw) if Hallam shows favorable potential this prototype would be the forerunning of a large commercial target plant. Would not be initiated before 1963 or 1964.

graphite clad elements and the plant will be increased to its designated rating of 46 Mw. The project will cost an estimated $45 million, all but $17 million to be financed by Philadelphia Electric Co and HTRDA. Startup is scheduled for 1963.

### Proposed Experimental Gas-Cooled Reactor

**Experimental Gas Cooled Reactor** (EGCR)—This helium-cooled, graphite-moderated reactor, scheduled for completion in 1962 will be the first gas-cooled civilian power reactor in the U. S. It is being built at Oak Ridge, Tenn to have a net generating capacity of 22.3 Mw. Besides having some value as a power producing prototype for demonstrating cost and reliability of gas-cooled power reactors, EGCR will use its unusual flexibility to test advanced fuels in special in-pile loops and will also be used to advance the technology of gas-cooled reactors. Gas at 300 psi, 1,050 F is to be used to generate superheated steam at 1,300 psi, 900 F. Cost of the project is being underwritten by the Commission. It will be connected to the TVA system.

**What's Ahead for Gas-Cooled Reactors**

AEC PLANS FOR PRESENT GAS-COOLED PROJECTS

**Experimental Gas-Cooled Reactor** (EGCR) (22.3 Mw) will be used to test advanced fuels, materials, and components. Work will be in cooperation with work on UK's Advanced Gas Reactor.

**High Temperature Gas-Cooled Reactor** (HTGCR) (46 Mw) will try-out developments of impervious graphite, high-temperature components and auxiliaries, and methods for trapping fission products that might get into the gas coolant.

AEC's PROPOSALS FOR FUTURE GAS-COOLED PROJECTS

**Advanced Gas-Cooled Prototype** (100 Mw) could be initiated in the mid 1960's if EGCR and (HTGCR) prove success (HTGCR) approaches.

**Utilities should be able to decide** whether gas-cooled plants in 300 to 500 Mw sizes are economic in high fuel cost areas by the early 1970's, AEC predicts.

# 6. Sodium-Cooled Fast Reactors

●Sodium has many attractive features as a reactor coolant. It is liquid at relatively low temperatures, has a very high boiling point, reasonably low neutron absorption cross section, and excellent heat-transfer and heat-transport characteristics.

These qualities make possible very high steam cycle efficiencies. And, because of the negligible pressure required for sodium systems, reactors of 500 Mw and larger are practical.

Most of the technical and economic advantages which are inherent in sodium as a coolant apply to fast reactor systems. In addition, they have an advantage over sodium-cooled thermal reactors in that they can achieve high conversion ratios, in other words, breed.

Research and development in fast reactor systems is long range. It is expected to yield results in the late 60's, AEC predicts. Work will be focused on use of plutonium and U-233 fuels; uranium and thorium as blanket materials. There will be work on rapid fuel recycle methods, and on cheaper and more reliable sodium components for temperatures up to 1,200 F.

### Present Prototype Fast Breeder Projects

**Enrico Fermi Fast Reactor**—This 100-Mw prototype power plant at Monroe, Mich, is now scheduled to go critical in December 1960. It will yield performance data on uranium-molybdenum alloy fuel, fuel management, fast reactor core physics and overall plant performance. It is a first round plant under AEC's Power Demonstration Reactor Program, being privately-financed by Detroit Edison Co and the Power Reactor Development Co with Atomic Power Development Associates doing research and development and furnishing reactor design.

Construction began in August 1956 and is proceeding on schedule toward completion in September 1960, with critical operation in December, 1960. All buildings are complete, and the auxiliary equipment is being installed. Reactor erection is complete and non-nuclear testing is about finished.

**Experimental Breeder Reactor-1** (EBR-1) This oldest of all civilian power reactors will have a core containing plutonium installed in mid 1960. It will be the

**ENRICO FERMI** Detroit Edison Co's sodium-cooled fast reactor plant is scheduled for started up in December this year

**What's Ahead for Sodium Cooled Fast Reactors**

**AEC PLANS FOR PRESENT FAST REACTOR PROJECTS**

**Experimental Breeder Reactor** (EBR-1) will continue operation. When present safety experiments are finished a new plutonium cermet core will be installed.

**Experimental Breeder Reactor** (EBR-2) due for criticality this year will have a first core of U-235 fuel. Subsequent cores will be fueled with plutonium. The plant incorporates pyrometallurgical fuel processing.

**Enrico Fermi Plant** (94 Mw) will gather test data on uranium 10% molybdenum fuel performance, fuel rotation, fuel processing, core physics and overall plant performance; all important to the future of fast reactors.

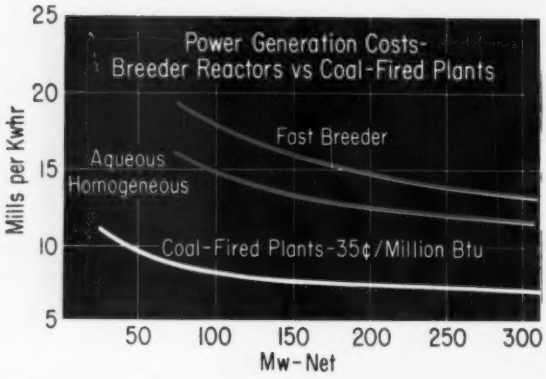
**AEC's PROPOSALS FOR FUTURE FAST REACTOR PROJECTS**

**Prototype Sodium-Cooled Fast Reactor** (100 Mw) will be next if present reactors show promise. Design and construction could start in 1963 or 1964. Aim would be to try-out use of a mobile blanket, paste fuel, plutoneum oxide fuel and higher team conditions.

**Utilities should be able to decide** whether fast breeder plants are economic in many areas by the late 1960's AEC estimates.

fourth core for EBR-1 which has been operable since 1951. EBR-1 is located at the National Reactor Testing Station, Arco, Idaho, and has an electrical capacity of 150 kw.

**Experimental Breeder Reactor-2** (EBR-2) AEC's second prototype fast breeder reactor, also at NRTS, is expected to achieve criticality the end of this year, and will have a capacity of 16.5 Mw. It will use U-235 as a metallic alloy with a mixture of fission products in its first core. Some plutonium bearing fuel will be tested preparatory to operation with a core of plutonium and depleted uranium. EBR-2 will have an integral fuel processing facility to cut reprocessing and inventory.




**BREEDER REACTORS,** of the sodium and aqueous types, if based on present technology could produce energy costing 12 and 13 mills. By the late 1960's research may reduce the cost to a probable 7 to 11 mills

## 7. Heavy Water

● Several unique advantages are possessed by heavy-water moderated, natural-uranium fueled reactors. They are independent of diffusion plants in the fuel cycle, have high neutron economy, and require small quantities of ore per unit of power. However, they are physically big, and so have high capital costs. Moreover, lifetime of the natural uranium fuel is more limited than enriched fuel AEC points out.

Today, in addition to the heavy water moderated reactors under construction or planned in the U. S., the Canadians are planning a 20-Mw prototype (the NPD) as well as a 200-Mw natural uranium $D_2O$ moderated power plant. These plants are scheduled for criticality in 1961 and 1965. Much of our future work will be done in, and will depend upon, close cooperation with Canada.

### Status of Present Heavy-Water Projects

**Carolinas-Virginia Nuclear Power Assoc**—Construction started in April 1960 at Parr, S. C., on this 17-Mw heavy-water-moderated and cooled pressure-tube reactor project which is scheduled for criticality in 1962. The project, which is to demonstrate feasibility and economic potential of the concept, is being designed, built, and operated by Carolinas-Virginia Nuclear Power Associates under terms of the third round of AEC's Power Demonstration Reactor Program at a cost of $28 million. Cost of AEC will be $14.6 million. Saturated steam to be generated in the reactor will be superheated by fossil fuel.

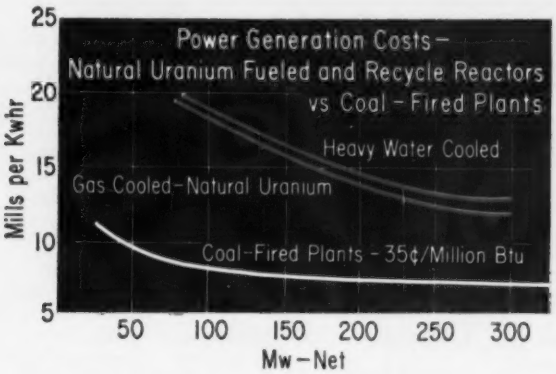
**East Central and Florida West Coast Nuclear Project**—A research and development program is being conducted jointly by AEC and the East Central and Florida West Coast Nuclear Groups in support of a projected 50-Mw gas-cooled heavy-water-moderated reactor which FWCNG will design, construct and operate provided it is technically feasible and energy cost does not exceed 1½ times conventional plant production cost. A site at Pierce, east of Tampa, has been selected. The scheduled criticality date is June 30, 1963.

## 8. Aqueous Homo

● For the production of power the aqueous homogeneous reactor offers advantages since it operates with a solution fuel, provides for continuous fission product removal, and is self-regulating due to its large negative temperature coefficient. Moreover, it offers the possibilities of breeding when operated on thorium-uranium 233 fuel. However, there are problems associated with the corrosive fuel, instability of the fuel solution, and the radioactive primary loop that make reactor maintenance difficult, AEC authorities point out. Other problems are posed by the limited operating temperatures and the attendant low steam-cycle efficiencies that go with them.

It is too soon to determine whether the simple fuel cycle and the possibilities of breeding will offset the complexities and temperature limitations, in the opinion of the AEC. However because of the unique ad-

# Moderated Reactors




**HEAVY WATER-COOLED REACTORS** and gas-cooled natural uranium plants, like those in the U.K. built today would show an energy cost 4 to 5 mills higher than conventional plants. Research may cut this margin by 4 mills by '69

**Plutonium Recycle Test Reactor** (PRTR)—This heavy water moderated and cooled pressure tube reactor will go critical in June 1960 at Hanford, Wash. It is to operate at power reactor temperatures and will be an important source of additional technology. Primarily, however, it is an experimental facility to investigate the economic feasibility of plutonium recycling. The reactor is rated at 70 Mwt. There is no electricity generated.

**Heavy Water Components Test Reactor** (HWCTG)—This pressurized-water moderated and cooled reactor of the pressure vessel type is currently being built at Savannah River, S. C. It generates no power. It will be used to expose natural uranium fuel assemblies to the conditions and environment expected in proposed full scale power reactors. The reactor has a capacity of 70 Mwt.

### What's Ahead for Heavy Water Reactor Projects

**AEC PLANS FOR PRESENT HEAVY WATER PROJECTS**

**Heavy Water Components Test Reactor** (HWCTR) this pressurized $D_2O$ cooled and moderated reactor will be used to expose natural-uranium fuel assemblies to the conditions they will encounter in full-scale power reactors. It will also test other components such as pumps, valves and instrumentation.

**Carolinas-Virginia Plant** (17-Mw) now in design is $D_2O$ moderated and cooled pressure tube reactor, using slightly enriched $UO_2$. It is first U. S. prototype.

**East Central and Florida West Coast Plant** (50 Mw) is undergoing evaluation to determine if construction should be started.

**Plutonium Recycle Test Reactor** (PRTR) will investigate the feasibility of plutonium recycling. It will use $D_2O$ coolant and moderator, in a pressure-tube design, so will be an important source of new data.

**AEC's PLANS FOR FUTURE PROJECTS**

**No projects were foreseen** but an evaluation will be made in 1966-1967.

### More Data on Civilian Power Reactors

On the following six pages Electrical World presents pertinent data on civilian power reactor projects now operating, under construction and planned. The tabulation covers prototype power plants, experimental reactors and reactor experiments associated with the civilian program.

# geneous Reactors

vantages and the fact that this is the main effort on fluid fuels, research and development will be continued on the technical problems on a long range basis, the AEC points out.

### Status of Aqueous Homogeneous Projects

**Homogeneous Reactor Experiment-2** (HRE-2)—This experiment at Oak Ridge is currently shut down for repair of two new holes in the zircalloy inner core tank. First hole in the core tank was found in 1958. Operation will resume this summer in an effort to solve problems such as suel stability and maintenance of a highly radioactive primary system. HRE-2 has been operated at pressures from 1,150 to 1,750 psig at 240 and 260 C and at power levels of 5,000 kwt to determine conditions under which chemical instability of fuel occurs. No such instabilities were observed.

### What's Ahead for Aqueous Homogeneous Reactors

**AEC PLANS FOR PRESENT AQUEOUS HOMOGENEOUS PROJECTS**

**Homogeneous Reactor Experiment** (HRE-2) will concentrate on fuel stability and corrosion problems in the core and development of blanket material, also a study remote maintenance.

**AEC's SUGGESTIONS FOR FUTURE PROJECTS**

**Third Homogeneous Reactor Experiment** will depend on outcome of research with uranyl sulfate fuel in HRE-2. It would be a small scale model of a two-region power reactor utilizing solution core fuel and a slurry blanket fuel.

**Prototype Homogeneous Plant** (50 Mw) could be initiated in the late 1960's if the HRE-3 experiment is successful.

# Civilian Nuclear Power Reactor

| Ownership | AEC; Duquesne Light Co. | Commonwealth Edison Co; N.P.G. | Yankee Atomic Elect. Co. | Consolidated Edison Co. of N.Y. | Detroit Edison Co; Power Reactor Dev. Co. |
|---|---|---|---|---|---|
| Plant & location | Shippingport, Pa. | Dresden, Morris, Ill. | Yankee Atomic Elect Rowe, Mass. | Indian Point, Buchanan, N.Y. | Enrico Fermi Monroe, Mich. |
| Present status | Operating on 2nd seed of 1st core | Operating at half power | Being built | Being built | Being built |
| Type of financing | AEC + Private | Private[3] | AEC Power Demo. Program | Private | AEC Power Demo. Program [10] |
| Reactor type | Pressurized water | Dual cycle boiling water | Pressurized water | Pressurized water | Fast neutron power breeder |
| Start-up date | Dec., 1957 | Sept., 1959 | Mid-1960 | 1961 | Dec-1960 [12] |
| Reactor mfgr. | Westinghouse | General Electric | Westinghouse[6] | Babcock & Wilcox | Power Reactor Development Co. |
| Reactor thermal Mw | 236 | 626 | 492 (392 initial) | 585 | 300 |
| Gross generating capacity, Mw | 68 (100 ult.) | 180 (net) | 145 (120 initial) | 275[8] | 100 |
| Est. cost of reactor, $ million[1] | 55 | ..... | 24.2[7] | 45[9] | 37.9[11] |
| Est. cost turbo-gen plant, $ million | 20 | ..... | 15.4[7] | 55 | 17.0 |
| Total est. plant cost, $ million | 75 | 45[4] | 53.1 | 100 | 54.9[11] |
| Total est. plant cost, $ per kw | 750 (100 Mw) | 250[4] | 366 | 363 | 549 |
| Est. energy cost, mills per kwhr | Downward from earlier 64.4 | 9–7.5[5] | 12–14 | 14.3 | ..... |
| Moderator | Light water | Light water | Light water | Light water | None |
| Coolant | Light water | Light water | Light water | Light water | Sodium |
| Coolant temp, F[2] | 500 | 525 | 508 | 500 | 800 |
| Coolant press, psi | 1,800 | 1,000 | 2,000 | 1,500 | 127 |
| Steam temp, F | Saturated | 546 (pri) 467 (sec) | 470 | 1,000[8] | 740 |
| Steam press, psi | 520 | 1,000 (pri) 500 (sec) | 500 | 370 | 600 |
| Steam flow, lb per hr | 850,000 (60 Mw) | 1,400,000 (pri) 1,200,000 (sec) | 1,800,000 | 2,200,000 | 960,000 |
| Fuel enrichment, % U-235 | >90% in seed Nat. uranium in blanket | 1.5 | 3.4 | Fully enriched. Thorium is fertile material | 25.6 |

[1] Not including R&D, fuel fabrication for first charge, or nuclear materials unless noted otherwise
[2] Average temperature of coolant in reactor unless otherwise noted
[3] Commonwealth Edison will pay $30 million plus $6 million for site and overheads (charged to plant account). Remaining $15 million will be supplied over period of 5 years by Nuclear Power Group.
[4] Based on contract price
[5] For second and later cores and not capitalizing $15 million R&D
[6] Plant design joint with Stone & Webster
[7] Equipment and installation only
[8] Will use separately-oil-fired superheater to raise steam temp from 450 to 1000F. Sphtrs provide 112 Mw capacity, reactor 163 Mw
[9] Nuclear portion of plant
[10] AEC-PRDC contract under the Power Demonstration Reactor Program provides that the Commission perform breeder reactor research and development, valued at $4.5 million and waive fuel use charges of $3.7 million.

# Projects Built or Planned in U.S.

| AEC; Consumers Pub. Pwr. Dist. | AEC; Rural Coop. Pwr. Assn. | AEC; City of Piqua | Northern States Pwr. Co. | Carolinas-Virginia Nuclear Pwr. Assoc., Inc.[15] | Pacific Gas & Electric Co. |
|---|---|---|---|---|---|
| Hallam, Neb. | Elk River, Minn. | City of Piqua, Ohio | Pathfinder Plant, Sioux Falls, S. D. | Parr, S. C. | Humboldt Bay Eureka, Cal. |
| Being built | Being built | Being built | Design in progress | Being built | Design completed |
| AEC Power Demo. Program | AEC Power Demo. Program | AEC Power Demo. Program | AEC Power Demo. Program | AEC Power Demo. Program | Private |
| Sodium-graphite | Boiling water | Organic cooled and moderated | Boiling water, nuclear Superheater | Pressurized water, pressure tube | Boiling water |
| 1962 | 1960 | 1961 | 1962 | Mid-1962 | Mid-1962 |
| No. American Aviation, Inc. | Allis Chalmers Mfg. Co. | No. American Aviation, Inc. | Allis Chalmers Mfg. Co. | Westinghouse | General Electric |
| 254 | 58.2 | 45.5 | 203[14] | 61.9 | 165/197 |
| 81 | 22 | 10.5 | 66 | 19 | 50 guaranteed 60 expected |
| 29.0 | 9 | 4.5[13] | ..... | 4.3 | ..... |
| 12.3 | 2.7 | 1.03 (existing plant) | ..... | Existing plant | ..... |
| 41.3 | 11.7 | 15.3[13] | 22.6 | 19.4[16] | 20 (approx) |
| 550 | 506 | ..... | 334 | 1,300 | 400 on guarantee 333 expected |
| 10–11 | 12.6 | 10–11[13] | ..... | ..... | 8.0 (sec. core) |
| Graphite | Light water | Terphenyl | Light water | Heavy water | Light water |
| Sodium | Light water | Terphenyl | Light water and steam | Heavy water | Light water |
| 950 (outlet) | 538 | 575 | 489 | 555[17] | 545 |
| 10 | 950 | 120 | 600 | 1,500 | 1,000 |
| 825 | 538 (pri) 506 (sec) | 550 | 825[14] | 725[18] | 545 |
| 800 | 950 (pri) 600 (sec) | 450 | 540 | 605[19] 400[20] | 1,000 |
| 730,000 | 258,000 (pri) 225,000 (sec) | 150,000 | 618,500 | 201,000 | 580,000 (50 Mw) |
| 2.5 | Fully enriched uranium in thorium oxide | 1.8 | 1.8 boiler 93 sphtr. | <2 | 2% in $UO_2$ zircaloy clad |

PRDC, APDA and Detroit Edison furnished $80 million for research and development and construction cost

[13] Does not include R&D or fuel fabrication expense

[14] An additional 4 to 6 mo has been allowed for refinement of fuel element design, but the start up date is as indicated

[15] Costs being revised to provide for complete reactor containment

[16] Will use nuclear sphtr to raise steam tem from 489 to 825 F. Sphtr will provide 39 Mw, reactor 164 Mw

[15] Members are: Carolina P&L Co., Duke Power Co., Virginia E&P Co., South Carolina E&G Co

[16] Does not include esculation

[17] At outlet

[18] After oil-fired superheater

[19] At steam generator outlet

[20] At throttle

[21] Containment unsettled

# Civilian Nuclear Power Reactor

| Ownership | Consumers Power Co. | AEC; Undetermined utility organization | East Central & Florida West Coast Nuclear Gr'p[3] | Philadelphia Electric Co; HTRDA | AEC; Undetermined publicly owned utility |
|---|---|---|---|---|---|
| Plant & location | Big Rock Point Mich. | Small plant, undetermined location | Pierce, Florida | Peach Bottom (Pa.) Atomic Power Station | Undetermined |
| Present status | In design | Authorized | R&D in progress | In design | Authorized |
| Type of financing | AEC Power Demo. Program | AEC Power Demo. Program | AEC Power Demo. Program[7] | AEC Power Demo. Program[5] | AEC Power Demo. Program |
| Reactor type | High power density direct-cycle boiling water | Pressurized water | Gas-cooled, heavy water moderated pressure tube | High-temperature, gas-cooled | Improved cycle boiling water |
| Start-up date | Late-1962 | 1962 | Mid-1963 | 1963 | 1964 |
| Reactor mfgr. | General Electric | ..... | ..... | General Dynamics | ..... |
| Reactor Thermal Mw | 156 (240 Ultimate) | 60 | 153.4 | 115 | ..... |
| Gross general capacity, Mw | 50 (75 Ultimate) | 22 | 57.3 | 46 | 50 |
| Est. cost of reactor, $ million[1] | ..... | ..... | 15.4 | ..... | ..... |
| Est. cost, turbo-gen plant, $ million | ..... | ..... | 13.5 | ..... | ..... |
| Total est. plant cost, $ million | 26.7 | 14.0 | 28.9 | 24.5[6] | 20 |
| Total est. plant cost, $ per kw | 356 (75 Mw basis) | ..... | 580 | 610[6] | ..... |
| Est. energy cost, mills per kwhr | ..... | ..... | ..... | ..... | ..... |
| Moderator | Light water | Light water | Heavy water | Graphite | Light water |
| Coolant | Light water | Light water | Gas | Helium | Light water |
| Coolant temp. F[2] | 525 (1050 psia) | 490 (outlet) | 1,050 (out et)[4] | 1,382 (outlet) | 544 (outlet) |
| Coolant press, psi | 1,050 (1500 ult.) | 2,000 | 520[4] | 300 | 1,000 |
| Steam temp. F | 546 | 504 | 950[4] | 1,000 | 544 |
| Steam press, psi | 1,000 (1450 ult.) | 1,750 | 1,450[4] | 1,450 | 1,000 |
| Steam flow, lb per hr | 606,000 (initial) | ..... | 350,000 | 367,000 | ..... |
| Fuel enrichment, % U-235 | 3.9 (initial) | 3.4 | Slightly enriched | Highly enriched U 1 : 6.25 with thorium | 1.9 |

[1] Not including R&D, fuel fabrication for first charge, or nuclear materials, unless noted otherwise
[2] Average temperature of coolant in reactor, unless otherwise noted
[3] Members of FWCNG are: Florida Pwr Corp., and Tampa Electric Co. Members of ECNG are: Appalachian Elec Pwr Co., Ohio Pwr Co., Col & So Ohio Elec Co., Louisville G&E Co., Penn Pwr Co., Monongahela Pwr Co., West Penn Pwr Co., Indiana & Mich Elec Co., Cleveland Electillum Co., Dayton P&L Co., Ohio Edison Co., So. Indiana G&E Co., Potomac Edison Co, Indianapolis P&L Co.
[4] Design objectives
[5] Philadelphia Electric Co would provide $8 million, HTRDA $16.5 million, AEC would support R&D up to a reimbursable $14.5 million and waive

# Projects and . . . . . Experiments

| AEC; Puerto Rico Water Resources Board | Undetermined private-owned utility | So. California Edison Co | (AEC) Nat'l. Reactor Test Sta. | (AEC) Argonne Nat'l. Labs. | G.E.; Pacific Gas & Electric |
|---|---|---|---|---|---|
| BONUS, Punta Higuera, Puerto Rico | Undetermined | Undetermined | Experimental Breeder Reactor–1 Arco, Idaho | Experimental Boiling Water Reactor, Lemont, Ill. | Vallecitos Boiling Water Reactor, Vallecitos, Cal. |
| In design | Authorized | Letter of intent | Operable | Operable | Operable |
| AEC Power Demo. Program | AEC Power Demo. Program | Private | AEC | AEC | Private |
| Boiling water Nuclear suphtr. | Organically-cooled and moderated | Pressurized water | Fast breeder | Boiling water | Boiling water |
| 1962 | 1964 | 1964–65 | 1951 | 1956 | 1957 |
| ..... | ..... | Westinghouse | ..... | ..... | General Elec. |
| 50 | 50 to 100 | 1,150 | 1.4 | 20 | 30[11] |
| 17.3 | 50 | 360 | 200 Kw | 5.0 | 5 |
| ..... | ..... | ..... | ..... | ..... | 2.5[12] |
| ..... | ..... | ..... | ..... | ..... | 0.572 |
| 14.35 | ..... | 70 | ..... | ..... | 3 |
| ..... | ..... | 194[8] | ..... | ..... | 600 (at 5 Mw) |
| ..... | ..... | 7.3[9] | ..... | ..... | ..... |
| Light water | Organic | Light water | None | Light water | Light water |
| Light water | Organic | Light water | Sodium potasium | Light water | Light water |
| 950 (outlet) | ..... | 567 (outlet) | 600 (outlet) | 488 (outlet) | 545 |
| 900 | ..... | 2,150 | 15 | 600 | 1,000 |
| 900 | >600 | 680 | 525 | 470 | 545 |
| 850 | ..... | Dry & Satur. | 400 | 560 | 1,000 |
| ..... | ..... | 4,500,000 | 3,630 | 60,600 | 90,000 at 30 Mw |
| 1.8 | Slightly enriched | Slightly enriched | 90 | 1.44 | Enriched $U_2O$ in stainless cladding |

up to $2.5 million fuel use charges
[6] Fixed price contract including escalation
[7] R&D costs financed 50% AEC, 50% by utilities. Plant costs financed by FWCNG
[8] Excludes land and interest during construction
[9] Based on previous program announcement by Westinghouse (EW ,Oct 5 1959, p 94)
[10] At turbine throttle
[11] Authorized to operate at 50 Mwt maximum
[12] Not including land, supporting facilities and similar items required for commercial-sized reactor plant

# Experimental Reactor Projects

| Ownership | AEC; So. Cal. Edison Co. | AEC; Nat'l. Reactor Testing Sta. | AEC; Oak Ridge Nat'l. Lab. | AEC; Nat'l. Reactor Test. Sta. | AEC; Nat'l. Reactor Test. Sta. |
|---|---|---|---|---|---|
| Plant & location | Sodium Reactor Experiment, Santa Susana, Cal. | Organic Moderated Reactor Experiment NRTS, Idaho | Homogeneous Reactor Experiment-2, Oak Ridge, Tenn. | Experimental Breeder Reactor-2, NRTS, Idaho | Boiling Reactor Experiment-5, NRTS, Idaho |
| Present status | Operable | Operable | Operable | Being built | Being built |
| Type of financing | AEC | AEC | AEC | AEC | AEC |
| Reactor type | Sodium graphite | Organic-cooled and-moderated | Aqueous Homogeneous | Fast Breeder | Boiling water with nuclear superheat |
| Start-up date | 1957 | 1957 | 1957 | 1960 | 1960 |
| Reactor mfgn. | Atomics Int'l | Atomics Int'l | Oak Ridge Nat'l Lab | Argonne Nat'l Lab | Argonne Nat'l Lab |
| Reactor thermal Mw | 20 | 5 to 12 | 5.0 | 62.5 | 20 |
| Gross Generating capacity, Mw | 6 | None | Negligible | 20.0 | 2.5 |
| Est. cost of reactor, $ million[1] | 6.58 | ..... | ..... | ..... | ..... |
| Est. cost, turbo-gen plant, $ million | 1.3 | ..... | ..... | ..... | ..... |
| Total est. plant cost, $ million | 7.88 | ..... | ..... | ..... | ..... |
| Total est. plant cost, $ per kw | 1,050 | ..... | ..... | ..... | ..... |
| Est. Energy cost, mills per kwhr | ..... | ..... | ..... | ..... | ..... |
| Moderator | Graphite | Organic | Heavy water | None | Light water |
| Coolant | Sodium | Organic | Heavy water | Sodium | Light water |
| Coolant temp. F[2] | 960 (outlet) | 700 (outlet) | 572 (outlet) | 900 (outlet) | 825 (outlet) |
| Coolant press, psi | 3 | 200 | 2,000 | 60 | 600 |
| Steam temp. F | 825 | None | 471 | 850 | 825 |
| Steam press, psi | 600 | None | 520 | 1,250 | 550 |
| Steam Flow, lb per hr | 75,500 | None | 16,680 | 249,000 | ..... |
| Fuel enrichment, % U-235 | 2.8 (1st core) | 90 | 90 | 49 | ..... |

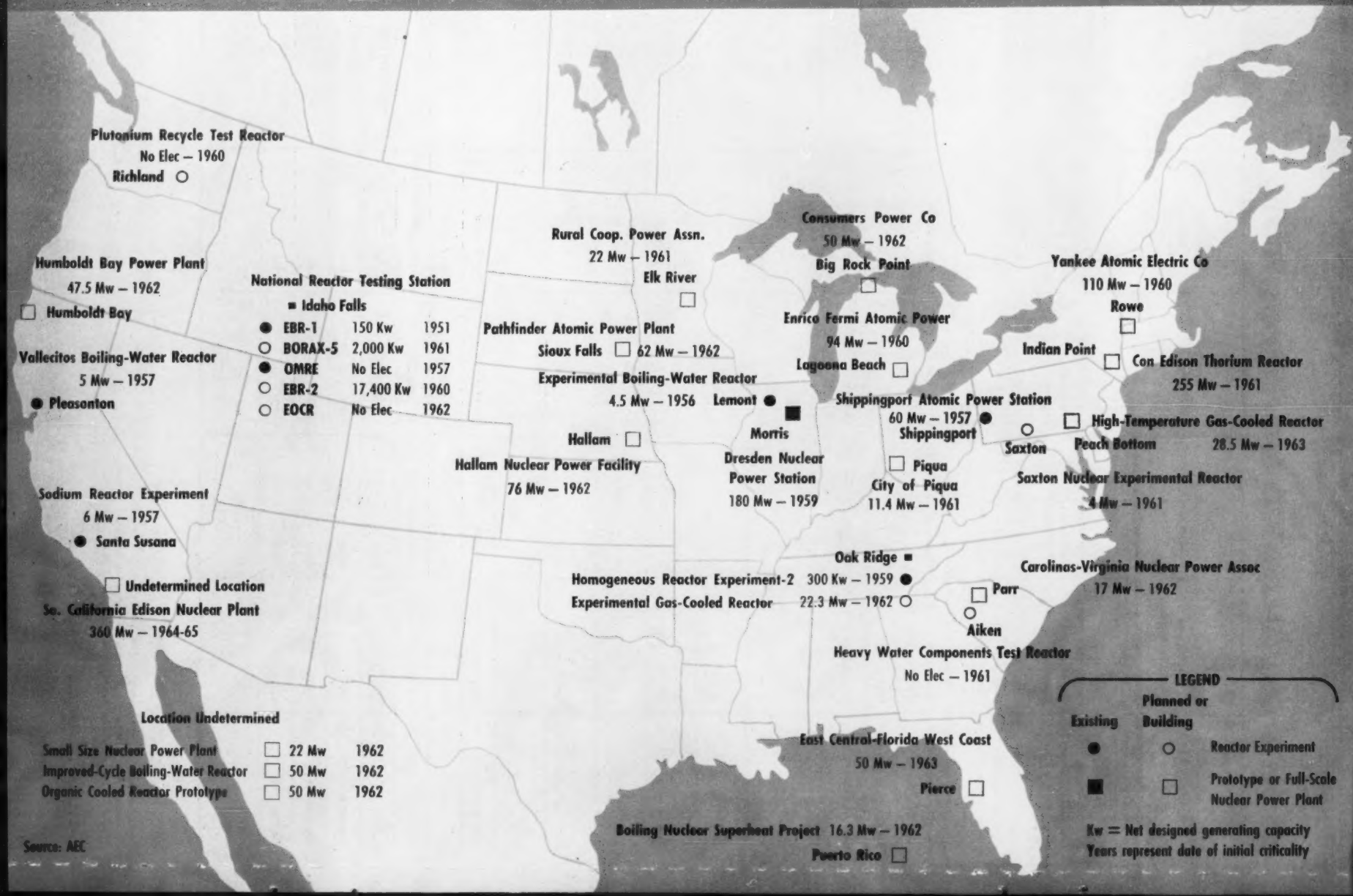
[1] Not including R&D, fuel fabrication for first charge, or nuclear materials unless noted otherwise
[2] Average temperature of coolant in reactor unless otherwise noted

# of the Civilian Power Program

| General Public Utilities | AEC; Oak Ridge Nat'l Laboratory | AEC; Nat'l. Reactor Test Sta. | AEC; Hanford Works | AEC; Savannah River Plant | |
|---|---|---|---|---|---|
| Saxton Nuclear Experment, Saxton, Pa. | Experimental Gas Cooled Reactor, Oak Ridge | Experimental Organic Cooled Reactor, NRTS, Idaho | Plutonium Recycle Test Reactor, Hanford | Heavy Water Components Test Reactor, Savannah River, S.C. | |
| Contract Signed | Being Built | Planned | Being Built | Being Built | |
| Private | AEC | AEC | AEC | AEC | |
| Pressurized water | Gas-cooled graphite-moderated | Organic-cooled | $D_2O$ moderated and cooled | Pressurized $D_2O$ | |
| 1961 | 1962 | 1962 | 1960 | 1961 | |
| Westinghouse | Allis Chalmers | C. F. Braun & Co. | General Electric | DuPont | |
| 20 | 84.3 | 20–40 | 70 | 61 | |
| 4[5] | 29.4 | None | None | None | |
| ..... | 10 | ..... | ..... | ..... | |
| Existing unit | 2.0 | ..... | ..... | ..... | |
| 6.25[4] | 3.0 | ..... | ..... | ..... | |
| ..... | 1,200 | ..... | ..... | ..... | |
| ..... | 25[3] | ..... | ..... | ..... | |
| Light water | Graphite | Organic | Heavy water | Heavy water | |
| Light water | Helium | Organic | Heavy water | Heavy water | |
| 540 | 1,050 | 700 (outlet) | 530 (outlet) | 464 (outlet) | |
| 2,000 | 315 | 200 | 1,025 | 1,000 | |
| Saturated | 900 | None | None | None | |
| 500–600 | 1,310 | None | None | None | |
| 70,000 | 255,400 | None | None | None | |
| 4.0 | 2.6 | 90 | ..... | 93 | |

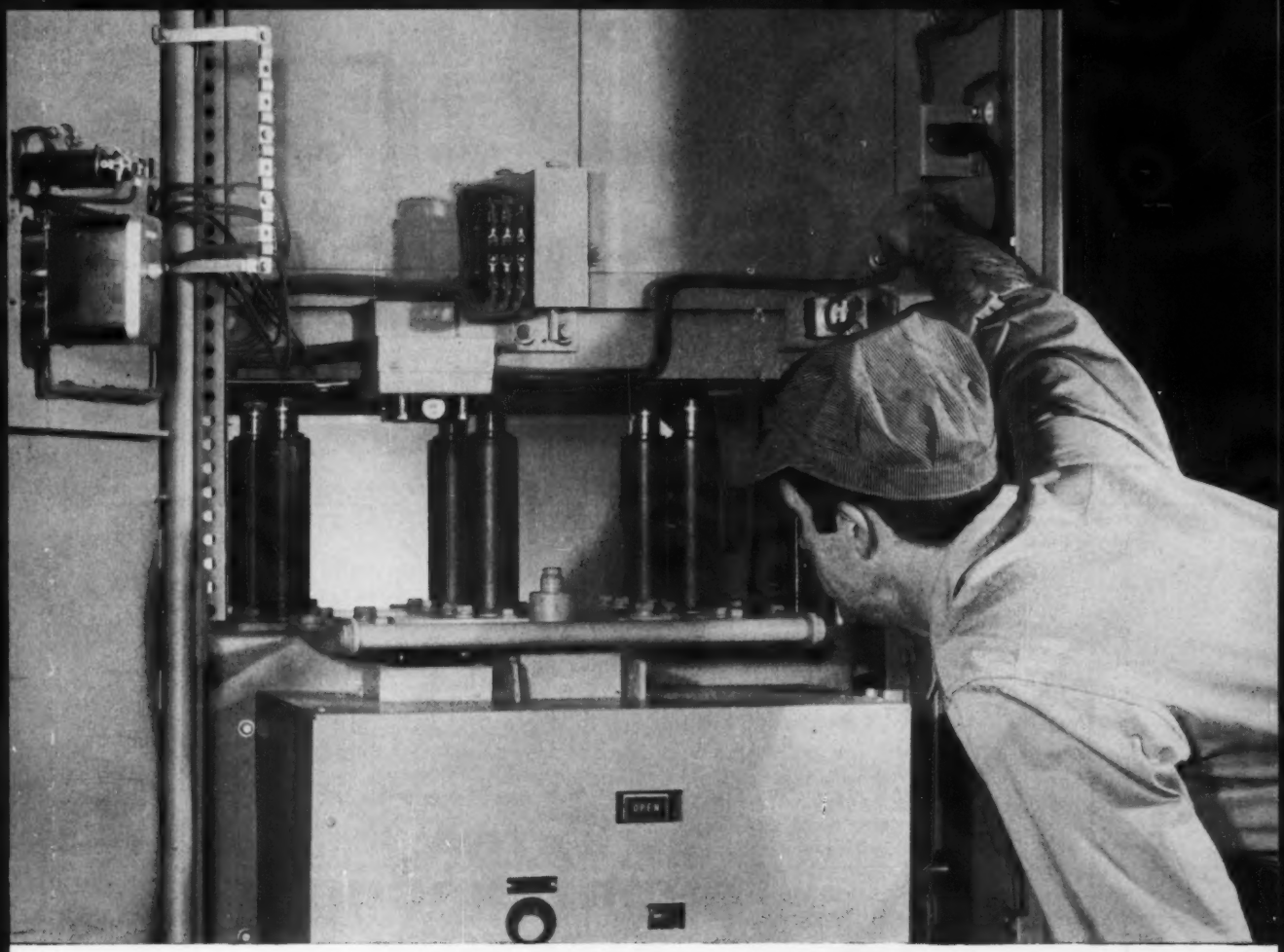
[3] Includes cost of experimental facilities
[4] Including fuel charges for 5 years (two or more cores)
[5] Capacity of associated turbine generator is 12 Mw

# Civilian Nuclear Power Projects of the U.S.



Change hats with your maintenance man, he will demonstrate . . .

# SAFETY YOU CAN SEE



## Only General Electric *Vertical Lift* Metal-clad Switchgear lets you see when it's disconnected

When your maintenance man operates General Electric Vertical Lift Metal-clad switchgear he can *see* when the primary disconnects are parted. He knows the breaker is safely open—a really important safety factor when he's working with thousands of volts of electricity.

General Electric Vertical Lift is the only switchgear design which gives you this safety bonus. Allowing your operator to visually check also reduces the possibility of outages which damage equipment and halt production.

Safety you can see is another reason why General Electric manufactures Vertical Lift design Metal-clad switchgear.

Contact your General Electric switchgear representative for more information, or write for Metal-clad bulletin, GEA-5664, to Section 511-37, General Electric Company, Schenectady 5, New York.

**VERTICAL LIFT'S 3 STEPS TO SWITCHGEAR SUPERIORITY:**

**STEP 1:** (Illustrated) Disconnect breakers automatically—only Vertical Lift design permits operator to actually see when disconnects are parted.

**STEP 2:** Remove breaker, slide out box barrier—Vertical Lift design allows operator to inspect contacts without moving arc chutes.

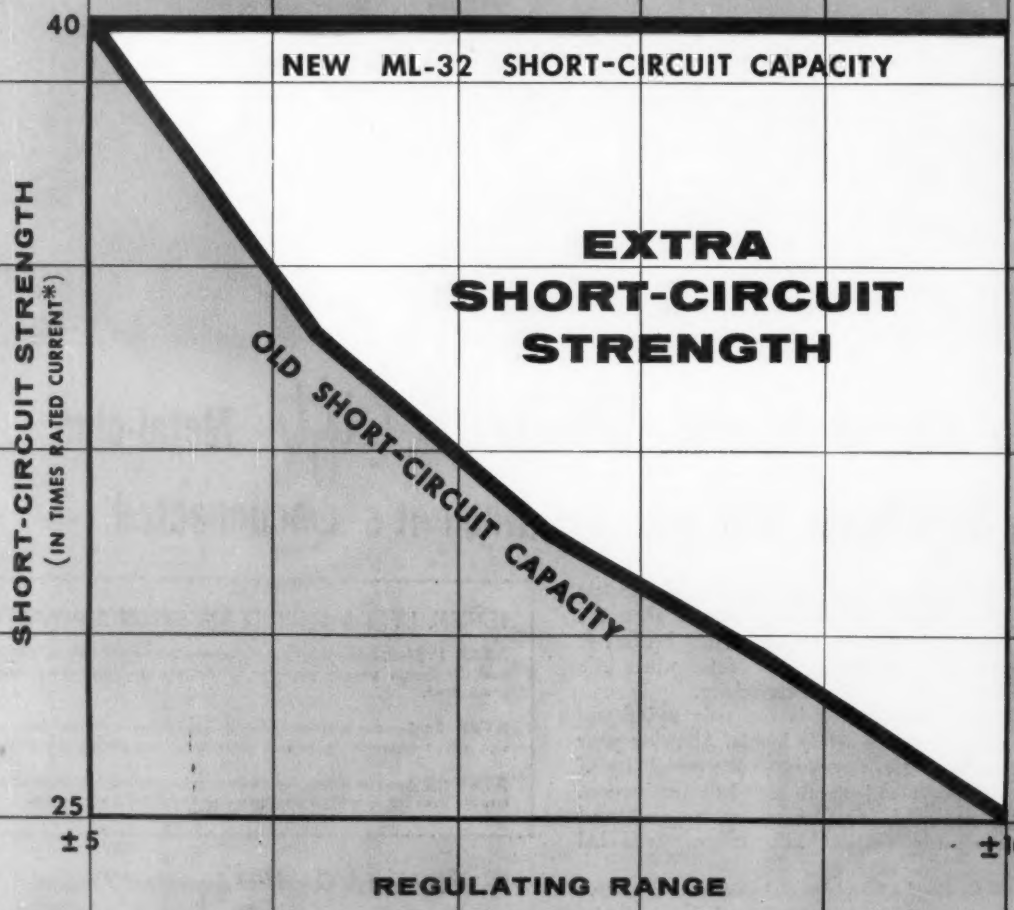
**STEP 3:** Remove protective cover—only Vertical Lift Metal-clad has the breaker operating mechanism up front for easy access.

*Progress Is Our Most Important Product*

GENERAL ELECTRIC

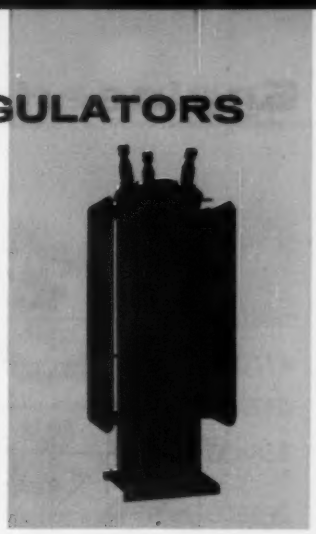
NOW STANDARD ON ALL GENERAL ELECTRIC

# 40 times rated current* short-




* *Rated current is the nameplate current at ±10% regulation.*

## SINGLE-PHASE STEP VOLTAGE REGULATORS



# circuit strength

New, stronger coil windings of General Electric single-phase ML-32 step voltage regulators will now withstand short-circuit currents of 40-times basic nameplate rating (the basic current rating at ±10% regulation) at all Load Bonus positions.

This increased short-circuit capacity is available for a duration of 0.8 seconds (48 cycles). With modern breakers, this time period gives ample leeway to detect a fault and de-energize the circuit.

Additional strength to resist high-current forces means increased protection against service outage under all current loads, plus even longer dependable life for already superior General Electric voltage regulators. Both of these important benefits are now available in G-E regulators at no increase in price.

These service extras are now possible because of the following G-E design improvements:

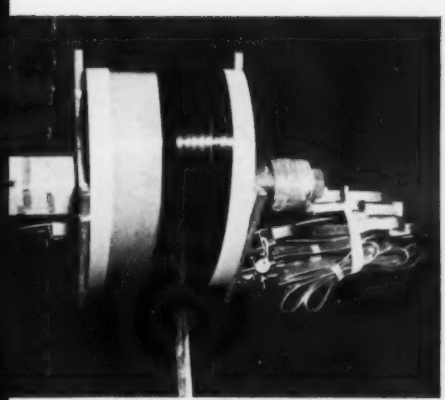
- **TIGHTER WINDINGS**—new coil winding process provides tighter, even coils; inherently stronger, better able to resist coil movement caused by short-circuit stresses.
- **SPECIAL INSULATION**—specially treated layer insulation forms a stronger winding-to-winding bond for finished coil. Additional protection added at points of most-severe stress to further resist coil shifting.
- **CONTROLLED DUCT SPACING**—cooling duct spacers are accurately positioned to hold windings firmly in place against radial forces during short circuits.
- **BALANCED WINDINGS**—coils are precisely aligned to resist destructive forces caused by short circuits.

This new high standard for voltage regulators is another dividend you receive from G-E research.

To learn more about all the reasons why G-E Voltage Regulators Cost Less on the Line, contact your nearby General Electric Apparatus Sales Office or Agent. Or write for Bulletin GED-3905, General Electric Company, Section 423-41, Schenectady 5, N. Y.

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**



**RUGGED COIL** wound by new process provides stronger resistance to forces caused by high short-circuit current.

**SPECIAL INSULATION** strengthens coil by stronger winding-to-winding bond, resists movement caused by short-circuit currents.

**EXTRA REGULATOR STRENGTH**

(for a typical ML-32 100-ampere unit)

| Regulating Range | Current Range | Former Short-circuit Capacity | NEW Short-circuit Capacity |
|---|---|---|---|
| ±10% | 100 amp (normal) | 2500 amp | 4000 amp |
| ±8¾% | 110 amp (load bonus) | 2750 amp | 4000 amp |
| ±7½% | 120 amp (load bonus) | 3000 amp | 4000 amp |
| ±6¼% | 135 amp (load bonus) | 3375 amp | 4000 amp |
| ±5% | 160 amp (load bonus) | 4000 amp | 4000 amp |

# Nomographs Aid in Preventing

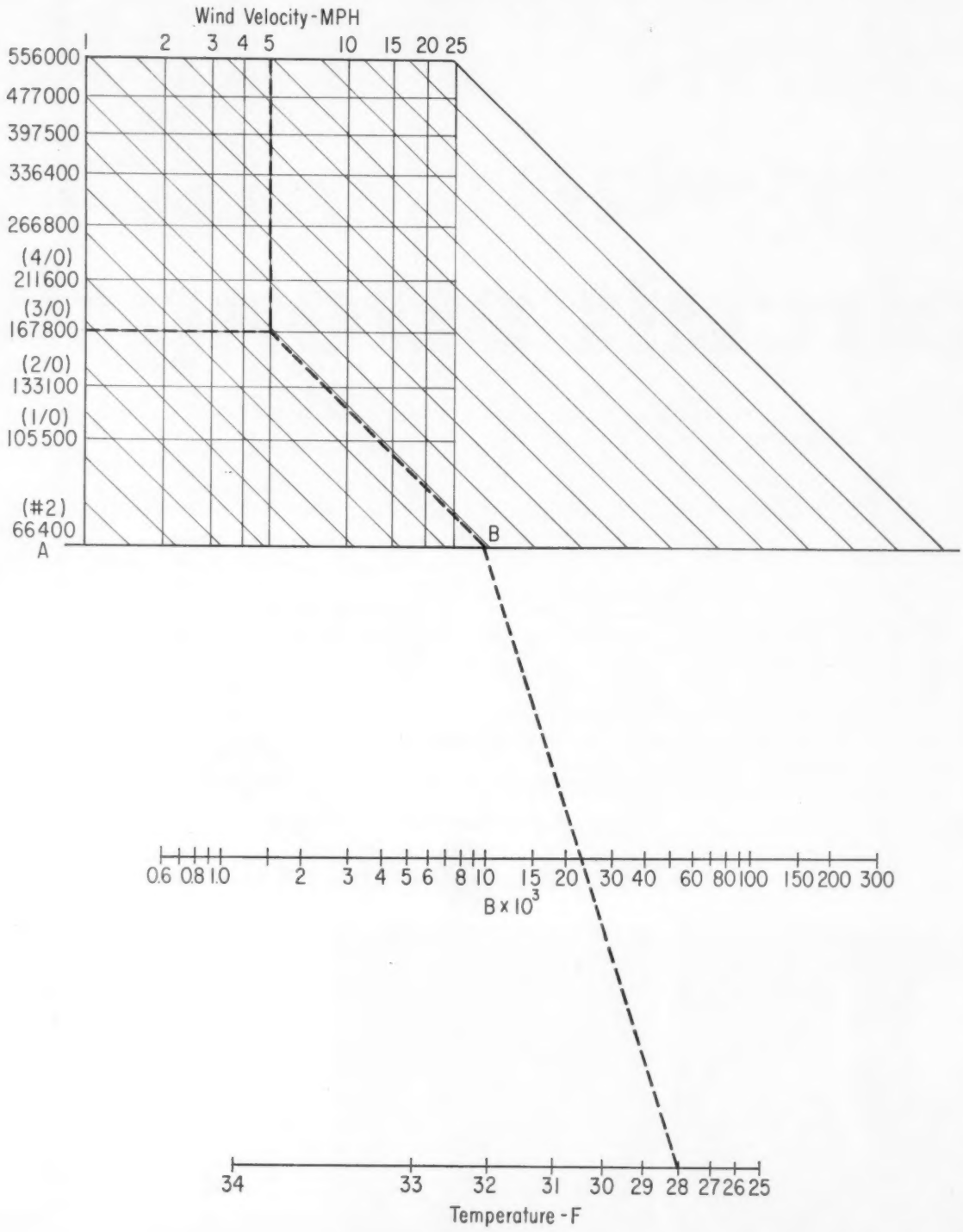



**CHART 1**

# Ice Formation on ACSR Conductors

**R. A. DEWBERRY**, Electrical Engineer, Montana-Dakota Utilities Co, Minneapolis, Minn.

Freezing rains and hoarfrost can cause considerable damage to utility lines. Thin coatings of ice may form on the conductors and, if followed by high winds, cause "galloping" which may swing wires together or pull down structures. Hoarfrost or a heavy buildup of ice may cause conductors to break or structures to buckle from overweight of ice.

By utilizing the $I^2R$ or line losses the conductor can be kept at a temperature slightly above freezing, thus preventing ice formation.

The current magnitude needed to prevent ice formation on conductors is dependent on (1) conductor resistance and cross sectional areas, (2) wind velocity and (3) ambient temperature. As ACSR conductors are almost universally used, only this type conductor is considered. This allows derivation of an expression in terms of A, the circular mil area, for both conductor resistance and cross sectional area.

To prevent the formation of ice on conductors by using electric current it is necessary to satisfy the equation

$$I^2R = (W_c + W_r)A_s \qquad (1)$$

where $A_s$ = surface area of conductor
$R$ = conductor resistance
$W_c$ = watts dissipated by convection,

$$= \frac{0.0128\sqrt{pv}}{\left(\frac{T_1+T_2}{2}\right)0.123_d{}^{0.5}}(T_1 - T_2) \text{ watts per sq in.} \qquad (2)$$

$W_r$ = watts dissipated by radiation

$$= 36.8\epsilon\left[\left(\frac{T_1}{1{,}000}\right)^4 - \left(\frac{T_2}{1{,}000}\right)^4\right]$$

$$= 18.4 \times 10^{-12}(T_1{}^4 - T_2{}^4) \text{ watts per sq in.} \qquad (3)$$

where $p$ = pressure (atmospheres)
$v$ = wind velocity (ft per sec)
$d$ = conductor diameter (in.)
$T_1$ = conductor temperature, K
$T_2$ = ambient temperature, K
$\epsilon$ = emissivity = 0.5 for conductors

Conductor diameter can be expressed approximately as a function of the circular-mil area:

$$d = \sqrt{\frac{1.5A}{1{,}000}} \text{ in.} \qquad (4)$$

Substituting **(4)** for d, converting wind velocity to mph, setting $p = 1$ and reducing, equation **(2)** becomes

$$W_c = \frac{13.76v^{0.5}(T_1 - T_2)}{A^{0.5}(T_1 + T_2)^{0.123}} \text{ watts per sq in.} \qquad (5)$$

Changing **(5)** and **(3)** to watts per ft and solving **(1)** for I,

$$R \text{ for ACSR conductor} = \rho/A = 17.75/A \text{ ohms per ft} \qquad (6)$$

$$I = \sqrt{\frac{35.8\times10^{-3}(274.82-T_2)Av^{0.5}+4.8\times10^{-14}(274.82^4-T_2{}^4)A^{1.5}}{(274.82+T_2)^{0.123}}}$$

$$= \sqrt{\beta + \Delta} \qquad (7)$$

where $\beta = 35.8 \times 10^{-3}\dfrac{Av^{0.5}(274.82 - T_2)}{(274.82 + T_2)^{0.123}}$

$$\Delta = 4.8 \times 10^{-14}A^{1.5}(274.82^4 - T_2{}^4)$$

Charts 1, 2 and 3 evaluate $\beta$, $\Delta$ and I respectively.

**Example.**

What current is required to prevent ice formation on 3/0 ACSR at 28F with a 5-mph wind?

Enter Chart 1 at 3/0 conductor and 5 mph wind. At their intersection follow diagonal to point B on line AA. Connect this point with a straight edge to 28F on temperature scale and read $\beta = 23 \times 10^3$.

Connect 3/0 conductor and 28F points on Chart **2** with a straight edge and read $\Delta = 98 \times 10$.

On Chart 3 connect $\Delta = 98 \times 10$ and $\beta = 23 \times 10^3$ and read current = 155 amp.

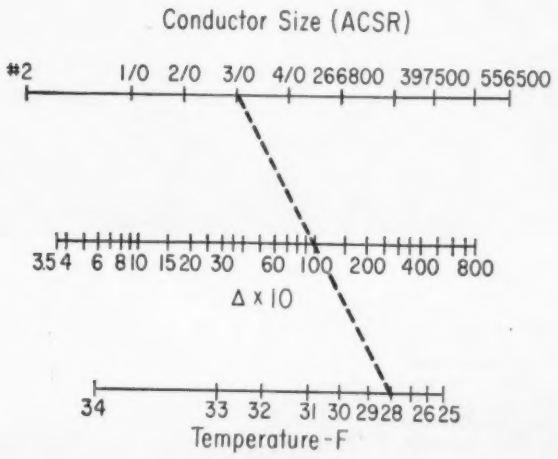



**CHART 2**

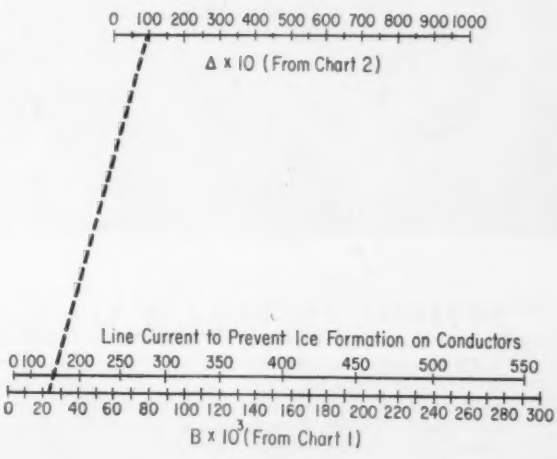



**CHART 3**

FULL-VALUE
CERTIFIED
TRANSFORMER
GENERAL ELECTRIC

- Superior design, features, and performance
- Faster shipment
- Complete service

# Transformer

## SYMBOL OF FULL VALUE

**With this seal, General Electric certifies full value for your transformer dollar; full value in terms of superior basic design, features, and performance . . . plus faster order handling and shipment . . plus complete service before, during, and after installation. No other transformer manufacturer can match this complete General Electric package.**

# shipment now 20% faster

**Use of digital computer reduces design time; permits faster production, delivery of General Electric medium transformers**

Faster product designing—through the use of a digital computer—now makes it possible for General Electric to reduce medium transformer* shipment schedules by as much as 20 percent.

Single-phase and many smaller three-phase units in the 501- to 7500-kva ratings are now shipped in five weeks! No more than six weeks are required for shipment of the largest standard-design three-phase units.

This faster shipment is the result of General Electric's efforts to reduce time spent in transformer design engineering. Normally, 40 hours of engineering are required for preliminary design —*now, with the computer, it takes just 20 minutes!* On final designs, the computer quickly selects proper sizes for all transformer parts—core, winding and tank. Sizes and weights to best meet specifications for a complete transformer and individual parts are computed in minutes. *This reduction in design time and expense is passed on as a direct shipment and product quality benefit to you.*

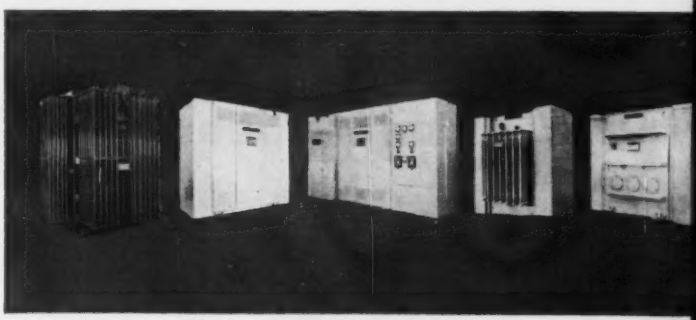
Computer-designed General Electric transformers also feature many basic improvements, including up to 20 percent reduction in height with negligible increase in floor space, and weight reductions up to 8000 pounds.

Ask your G-E Apparatus Sales Engineer to point out the many ways you save time and money with computer-designed transformers—another result of General Electric's *continuing* Certified Full-value Transformer Program. General Electric Company, Schenectady 5, N. Y.

416-30

*501 to 7500 kva, 69 kv and below.

**DIGITAL COMPUTER** cuts engineering and shipping schedules on G.E. medium transformers, saves customer time and money.



**FULL LINE** of Full-value Transformers by General Electric—left to right—Medium, Open Dry-type, Integral Distribution Centers, Distribution Equipment and Sealed Dry-type.

*Progress Is Our Most Important Product*

GENERAL ELECTRIC

# Con Edison Crews Plug in for Power

Power for portable tools and lighting may be as close as the nearest lamppost for underground distribution crews of Consolidated Edison Co. When one of the crews needs 115-v power for compressors, pumps or portable lighting, it can simply plug in to a nearby lamppost.

Since late 1957, Con Edison has installed over 1,000 power receptacles in lighting fixtures in locations where changes and maintenance in its manholes are most frequent. Crews working in these areas are equipped with more than 1,200 matching plugs. Receptacles and plugs are made by J. B. Nottingham & Co, Inc, and were developed in cooperation with the utility.

Personnel and the public are protected from accidential contact with "hot" connections. The receptacle is energized only after the special key-plug is inserted and turned. Inserting the plug also deflects a diaphram which protects the contacts in the receptacle from the weather.

Leads and plug and receptacle bodies are Neoprene insulated. A 30-amp cartridge fuse enclosed in the plug body is readily accessible through a removable cover. A Neoprene insulated cable attached to the plug body terminates in a two or three-prong socket for the power equipment.

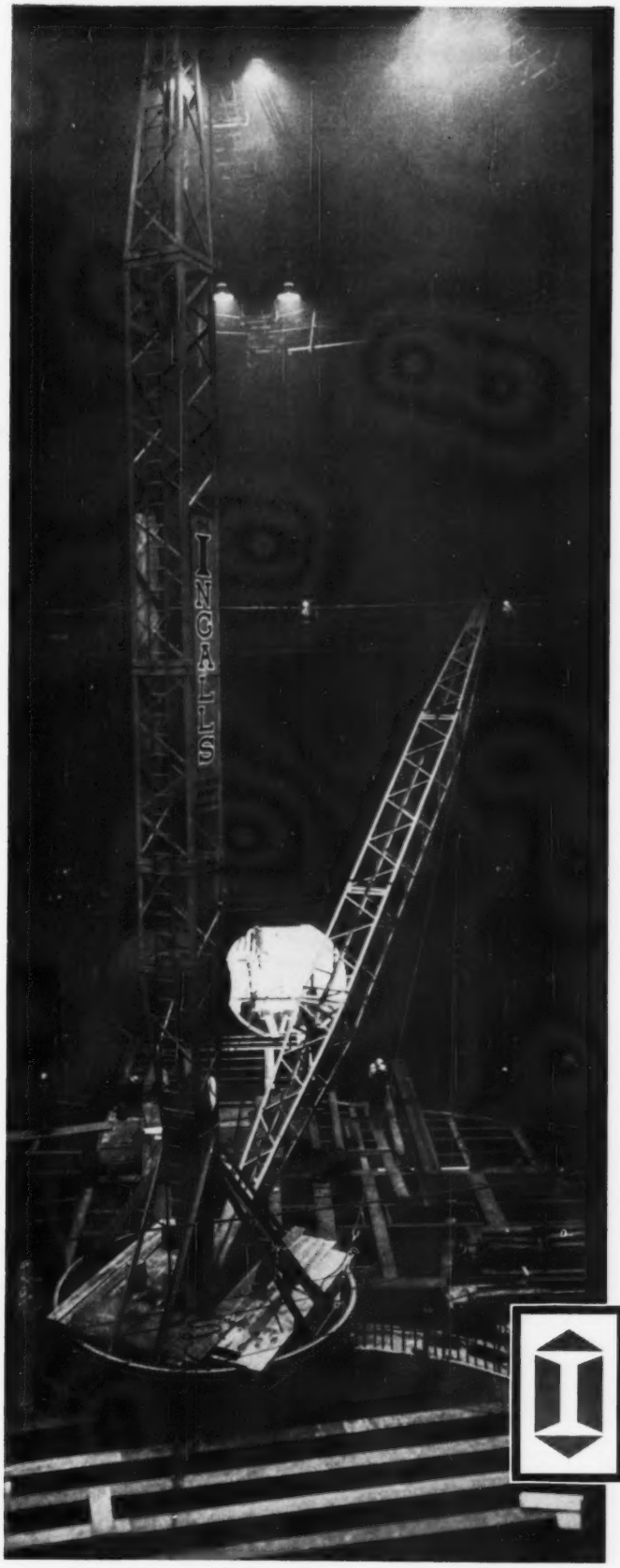
# TV Monitors See Oil or Gas Flame

Filters to detect oil or gas flames are a special feature of a closed-circuit television system for "firewatching" at the Scattergood Steam Plant of the Los Angeles Dept of Water & Power. Because the boilers in the Los Angeles plants are equipped to burn either fuel, the television camera is equipped to show both the red flame of oil and the nonluminous flame of gas.

The monitor system uses four KIN TEL Vidicon cameras mounted outside the boilers, directly opposite the burners. The boiler furnace is split by a dividing wall so that two cameras are used on each boiler. An air-cooled window in the boiler wall serves as the viewing port. Each camera sends its picture to one of four 14-in. monitors in the control room.

At one glance the operator can see 32 burners. A fifth camera and monitor, kept in reserve, are sometimes used to remotely view boiler water level at extremely high or low levels, beyond the capacity of conventional instruments. Operators at Scattergood Plant, with the aid of the monitors, can make a fuel switch in 2-3 min, a job that formerly took ten times as long.

(*More Methods on page* 94)



# INSIDE STORY

## ON UNIQUE ERECTION OF STRUCTURAL STEEL IN CONSOLIDATED EDISON'S NUCLEAR REACTOR POWER PLANT

No ordinary erection job, the structural steel construction of Consolidated Edison's $100-million nuclear power plant at Indian Point on the Hudson River, New York posed quite a problem.

The one inch outside steel shell and the five foot concrete shield of the nuclear sphere were completed by other contractors before Ingalls could begin from within on the interior structural steel framework! The concrete for the first section of the reactor shield was poured within the center of the sphere up to a 72′ elevation, then a specially designed thirty ton guy derrick was mounted on this reactor shield to erect the structural steel. And all this structural steel had to be "trolley-cabled" into the inside of the sphere through a 14′ diameter opening. When the steel for this phase is erected, the guy derrick will be removed from the reactor shield concrete to allow the concrete subcontractor to complete the pouring of the reactor shield to 110′ . . . after which the second and final phase of steel erection is carried through to "the top" of this 160′ diameter sphere finishing off with the erection of a 250 ton capacity "polar crane" to be used for handling the nuclear equipment.

*This unique type of erection called for careful planning and outstanding skill . . . plus team work by the Ingalls Companies – Ingalls Iron Works Company fabricated the structural steel and Ingalls Steel Construction Company erected the structure.*

THE
**INGALLS**
IRON WORKS COMPANY
Executive Offices
BIRMINGHAM, ALABAMA

New. . .
69KV-T.R. No. 216
Locke® Cat. No. 29069

# General Electric announces

## STATION POST INSULATORS

## with WIDE HOOD SPACING

- **breaks up drip stream**
- **eliminates heavy corona**
- **permits natural cleaning**
- **simplifies hot line washing**
- **improves effectiveness of NEMA leakage distances**

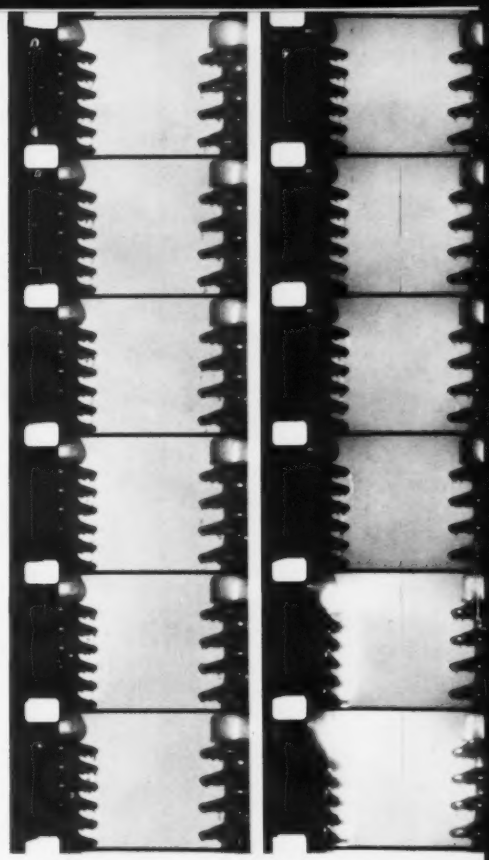
General Electric now offers you the first line of Station Post Insulators, 7.5 KV through 69 KV, that provides complete and effective utilization of the NEMA standard leakage distances. The new **wide hood** spacing has been scientifically proportioned to break up drip streams that normally gap old fashioned posts of narrow hood spacings. Note in the unretouched high speed movie strips, used by the design engineers, the effectiveness of the wide hood spacing.

Comparative tests between the **wide hood** spacing and the old fashioned station posts during rigidly controlled laboratory conditions clearly demonstrate the design problem is not merely *how much leakage distance . . .* but also, *how effective is the leakage distance?*

Sequential photographs, as shown at the right, vividly illustrate the superiority of the new station post for breaking up the drip stream, eliminating heavy corona, and promoting effective natural washing. The **wide hood** spacing facilitates convenient hot line washing of the insulator's hoods and barrel.

These **wide hood** station posts have been specifically designed to provide the quality characteristics you need and should expect from modern, advanced engineering and manufacturing techniques.

Obtain complete information from your Insulator Department representative — —or write for bulletin TIA-172, Insulator Department, General Electric Company, P. O. Box 57, Baltimore 3, Maryland.



Actual laboratory films available for showing.

Photographs at left (4000 frames/min.) show the sequence of droplet formation on our new wide hood spacing and older station post designs. Note the superiority of the new post in retarding bridging action and in breaking up the drip stream under actual line potential.

The right hand photographs taken under identical precipitation, (ASA standard wet test), show the pre-flashover corona streamers on the top hoods of the old fashioned post. Bridging action has reduced the effective leakage path and created localized voltage stress. A fraction of a second later, 60 cycle flashover occurs on the old fashioned post.

## EEI-NEMA STANDARD

*Trademark General Electric Co.

46KV-T.R. No. 214 Locke Cat. No. 29046

34.5KV-T.R. No. 210 Locke Cat. No. 29034

23KV-T.R. No. 208 Locke Cat. No. 29023

15KV-T.R. No. 205 Locke Cat. No. 29015

7.5KV-T.R. No. 202 Locke Cat. No. 29007

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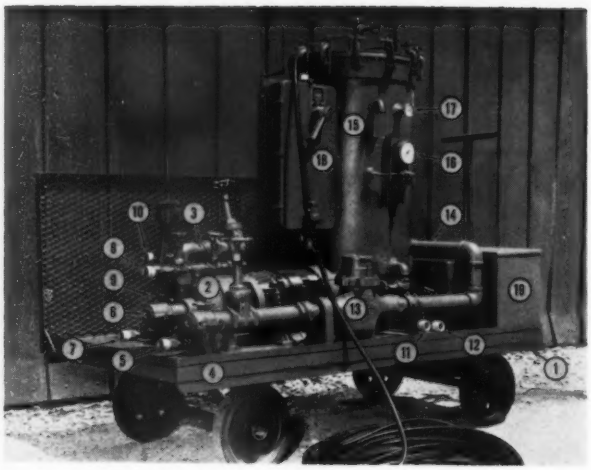
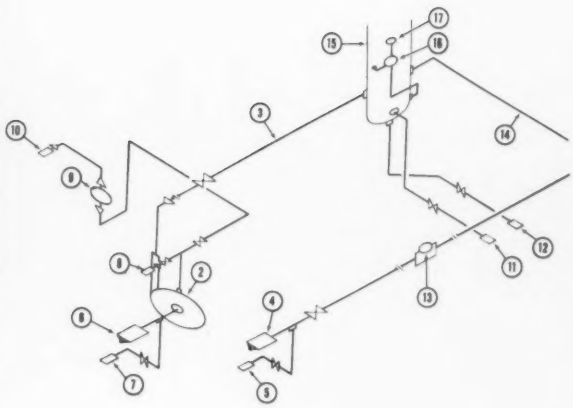




1. 48 x 72-in wagon truck.
2. Motorpump.
3. Pump discharge-filter inlet line.
4. Filter discharge, including 2-in. connection and dust plug.
5. ¾-in. discharge line connection.
6. Pump suction line, including 2-in. connection and dust plug.
7. ¾-in. suction line connection, including coupling.
8. Pump vent and sample line including ¾-in. coupling.
9. Hand pump for priming main pump.
10. Priming pump discharge connection including ¾ in. coupling.
11-12. Filter case drain lines including ¾ in. couplings.
13. Industrial 2-in. flow meter.
14. Filter discharge line.
15. Full flow filter.
16. Filter pressure gauge assembly.
17. Filter oil temperature indicator.
18. Combination switch and starter.
19. Accessories and tool box.

# Portable Unit Speeds Oil Filtering

A new system that speeds and improves oil filtering operations on large turbo-generator and transformer reservoir systems has been designed by Dow Chemical Co's lubrication department at Freeport, Tex. The company now has three large units built for about $1,800 each, and two small ones that cost under $500 apiece.

One of the large units will filter transformer oil at the rate of 150 gpm, while the smaller unit has an 18-20 gpm rate. This compares with standard small 10-gpm filter presses previously used.

Different types of filter elements are used on the portable self-contained units, depending on systems to be serviced. For turbo-generator and circulating oil systems, pleated paper elements of full-flow design having 10 micron filtering efficiency are used. These elements are treated to prevent water damage to the paper, although they do not remove the moisture.

For transformer oil, stacked paper disc type elements designed for full-flow service with 5 micron filtering efficiency are used. These elements are dried at 180F for 16 hr, then sealed in moisture-proof bags to insure maximum drying efficiency when put into service.

The portable filter units have been used on transformer oil "saturated with moisture and solid contaminants," where dielectric value was less than 15 kv. By circulating the oil through the filters at up to 150 gpm, for from 1 to 2 hr, the dielectric value was increased to 30 plus kv.

The small unit will do the same job as the big one, but was designed for smaller capacity systems. It will handle about twice the capacity of standard filter presses.

When the Dow filters are used on transformer oil, they use the same type paper as the filter presses, except in cartridges. There are no leaks because they are enclosed filter units, and since they are enclosed and self-contained they aren't affected by the weather.

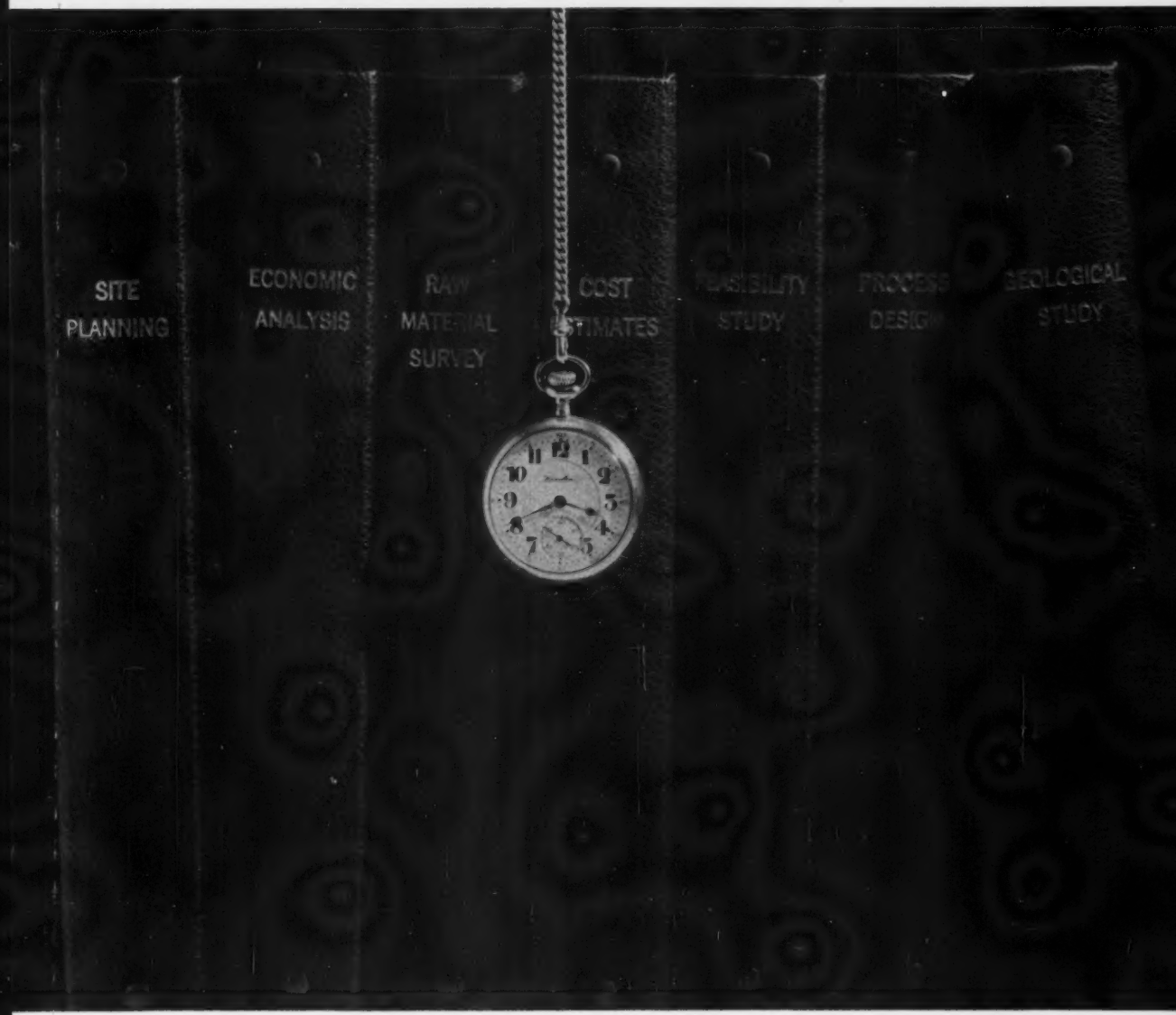
In field work, Dow reports it has emptied or filled a 4,500-gal capacity rectifier transformer in 45 minutes, including connecting the unit to the system and filtering the oil to remove solid contaminants and moisture. In addition, a transformer's oil can be circulated through one of the units to remove debris or improve the oil's dielectric value at any time a sample analysis indicates the need.

The units are used to filter reservoir oil in turbo-generators following overhauls, to remove foreign matter that may be flushed out of the oil system piping during initial circulation. The units can also be used to filter oil as it is transferred from storage tanks to reservoirs.

The units were developed by field people, and Dow reports it doesn't have "the answers to a lot of technical questions some may ask." However, the company's lubrication department will supply design data to any firm wanting it.

In one experiment, the company transferred a transport truck load of transformer oil into an oil storage tank in 1 hr, 45 minutes, with one man. Using a standard oil press, it would have taken a 4-man crew 18-20 hr.

# Pre-Engineering by **KAISER ENGINEERS** answers basic plant expansion questions...




**Timely?** Many complex factors shape the final decision to proceed with your expansion plans...and timing is an important one. Independent analysis of all aspects of your proposed program is the *Pre-Engineering* service offered by Kaiser Engineers. The studies and evaluations furnished by KE Pre-Engineering represent only one phase of total KE services. Kaiser Engineers designs and builds all types of power plants—steam-electric, gas turbine, combined cycle, nuclear, and hydro-electric. From Pre-Engineering through design and construction, Kaiser Engineers provides complete, one-company service and ingenuity based on years of experience.

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6228-P

# Procurement & Products

**PRICES** ▶ **Soft prices were reported on "many items** of electrical equipment" in the May business survey report of the National Association of Purchasing Agents. A month earlier NAPA had reported that prices were down on "certain items" of electrical equipment. I-T-E Circuit Breaker Co, which last week reported chaotic prices, announced first-quarter net income of $34,400, compared with $47,000 last year. Shipments for the 1960 period increased 18% to $29,654,100.

**Boiler feed pump prices were reduced approximately 10%** from former lists by the Harrison Division of Worthington Corp. Reasons: improvements in the manufacturing process and other cost reduction measures, said Worthington.

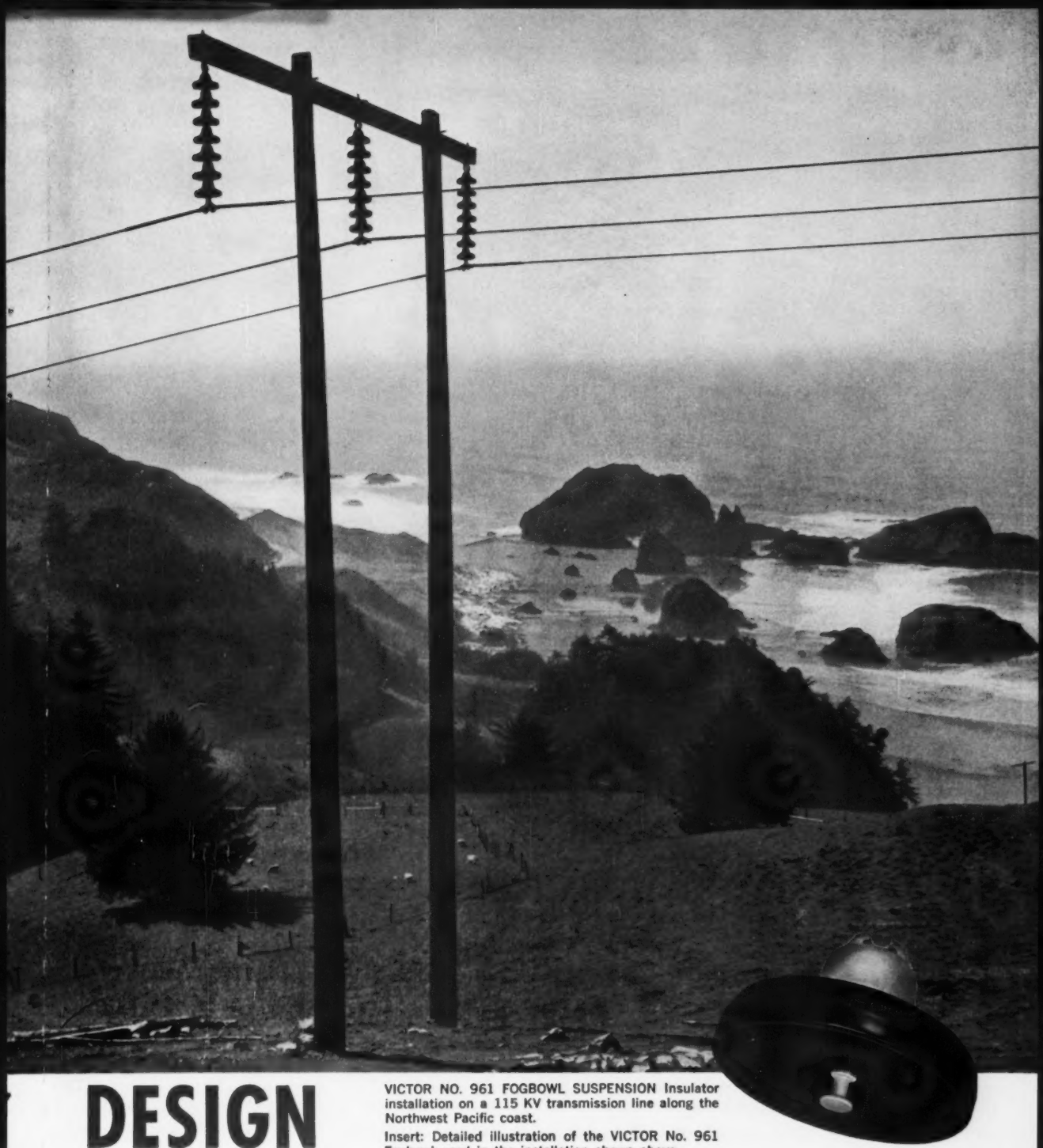
**PRICING POLICY** ▶ **Some PA's offered mild praise, others appeared disinterested** as General Electric Co's medium transformer dept made its second book price reduction under its new pricing policy. The cut was 5% on medium power transformers rated 2,000 through 7,500 kva. This cut followed on the heels of a 15% to 20% reduction April 11. Following the April 11 change, GE found that its book prices for transformers in the 2,000 to 7,500 kva range still were pegged 5% above the market price—and thus made the more recent reduction.

**This reflects the policy** of the medium power transformer department to keep changing the book prices as the market level changes, with a 5% differential being sufficient to warrant the change, said D. B. Lawton, general manager of the department. It is not known what other GE departments are following this pricing policy.

**INVESTIGATIONS** **FBI agents have requested records from at least 20** and very likely many more electric utility purchasing departments. The requests have been directed to the utility presidents and have specified purchasing records on certain items of switchgear for certain dates over the past two years. The Justice Dept gave no explanation as to what is was seeking, but observers surmised that the FBI was gathering evidence to be used in antitrust cases—and specifically to determine whether there was a differentiation between prices paid for certain products by the various utilities. The letter to presidents indicated that the material might be used in pending cases or in cases yet to be brought.

**ALUMINUM** ▶ **Aluminum fabricators have leveled sharp attacks** at primary producers for pricing practices that provides for exports of aluminum at prices several cents lower than the domestic price. In one or two cases fabricators are reported to have bought U. S.-made aluminum from foreign firms at prices cheaper than on the domestic market.

**NEXT WEEK** ▶ **EEI Purchasing & Stores Committee meeting in Philadelphia** centered its attention on improving operations and procedures within utilities. Full meeting story in next week's issue.



# DESIGN

VICTOR NO. 961 FOGBOWL SUSPENSION Insulator installation on a 115 KV transmission line along the Northwest Pacific coast.

Insert: Detailed illustration of the VICTOR No. 961 Fogbowl used in the installation shown above.

VICTOR has done more constructive research on insulators for contaminated areas than any other manufacturer in the field. Dramatic proof is the creation of the already famous No. 961 Suspension shown above.

Here is an entirely new concept in fogbowl insulator design . . . a totally different but effective answer to the problem of insulating in areas suffering from the contaminating effects of salt-laden air, fog, smog, dust, chemical or industrial fumes.

VICTOR No. 961 fogbowl suspensions were selected for this installation after exhaustive field tests conducted over a period of years on many makes of both conventional and fogtype insulators. The customer reports perfect service after years on the line . . . **with no expensive insulator washing.** Look to VICTOR when you have a contamination problem. For catalog, specifications and prices, contact your nearby VICTOR Sales Office. Victor Insulators Division, I-T-E Circuit Breaker Company, Victor, N. Y.

I-T-E | **I-T-E CIRCUIT BREAKER COMPANY**

# NOW YOU CAN GET SAFER, FASTER, LONGER-LASTING

## Anaconda Durasheath has a new clean-stripping, semi-conducting tape

The megohm meters (above) are measuring the surface resistivity on two samples of high-voltage, rubber-insulated, Shielded and Neoprene-jacketed cable immediately after the semi-conducting tape has been removed. The sample on the left (with a megohm meter reading in excess of 100 megohms) is Anaconda Durasheath incorporating the exclusive clean-stripping, semi-conducting tape. For comparison, the cable on the right with a low reading typifies old-style cable manufactured with ordinary semi-conducting tape.

The old-style cable requires tedious surface filing and buffing before it is clean of conducting particles, and ready for the tape build-up necessary to complete the splice or termination. Even after all these preparations, the surface may still be conducting because of the semi-conducting particles remaining deeply imbedded in the insulation.

New Anaconda Durasheath eliminates the need for excessive filing and buffing. Because the semi-con tape strips clean, the bared Durasheath insulation surface is left with only slight traces of easily

"Meggers"—courtesy James G. Biddle Co., Philadelphia, Pa.

# JOINTS AND TERMINATIONS ON HIGH-VOLTAGE CABLE

removed semi-conducting particles. The meter readings will show that a moment of buffing is all that's needed to complete surface preparation for tape build-ups and the most reliable splice or termination possible today.

The planned research and production program which brings you this outstanding cable development is also responsible for the equally important developments in Butyl rubber insulation compounding, and extruding, which have produced the best possible balanced design and construction in high-voltage rubber-insulated cable obtainable today—Anaconda Durasheath.

For more details, write for Anaconda Bulletin DM-5903, covering Durasheath High-Voltage Cable and DMS-5566, 5720 & 5735 dealing with the splicing & terminating of Durasheath Cable. Contact your nearest Anaconda Wire & Cable Company District Office, or write to: 25 Broadway, New York 4, N. Y. 60238 Rev.

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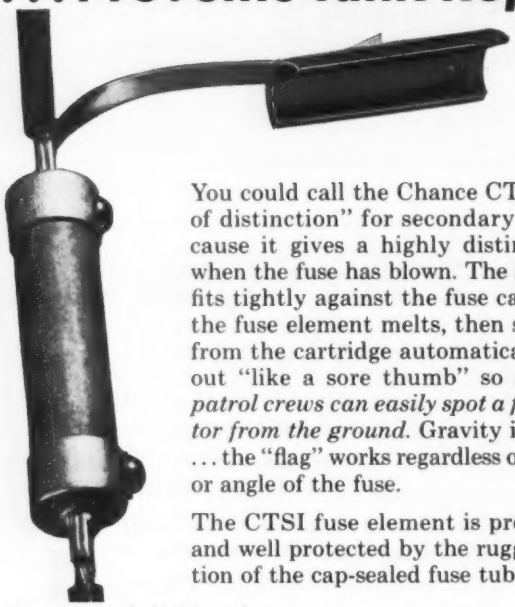
ABOUT DURASHEATH® CABLE

## . . . Signals Capacitor Failure
## . . . Prevents Tank Rupture



Equally effective on upright or underhung capacitors.

You could call the Chance CTSI the "fuse of distinction" for secondary systems because it gives a highly distinctive signal when the fuse has blown. The indicator flag fits tightly against the fuse cartridge until the fuse element melts, then springs away from the cartridge automatically, to stand out "like a sore thumb" so *linemen and patrol crews can easily spot a failed capacitor from the ground.* Gravity is no problem . . . the "flag" works regardless of the position or angle of the fuse.

The CTSI fuse element is precision made and well protected by the rugged construction of the cap-sealed fuse tube. You get no false outages but you do get instant isolation of failed capacitors to protect the secondary system and prevent hazardous tank rupture.

### Ideal protection for banked secondary systems

Chance Secondary Fuses, used between banked transformer secondaries, permit only one transformer and its load to be taken out of service if a secondary fault occurs. This prevents possible damage to the other transformers, or cascading of the fuses protecting these transformers. Check your possibilities for this application, too.

CF60-18

To get better indication whenever you use secondary fusing, use the Chance CTS or CTSI (insulated leads) fuse that waves the red flag. It's in your Chance catalog, or you can get performance curves and more complete information by contacting the Chance man or writing direct.

**A. B. CHANCE CO.**
CENTRALIA, MISSOURI
(A. B. Chance Company of Canada, Ltd., Toronto)

ABC INDUSTRIES

# IBM Announces New Computer Developments

## 'Off-the-shelf' program for utilities . . . faster magnetic tape system . . . large-scale, versatile Stretch computer

Three new developments in the computer field have been announced by International Business Machines Corp. One is a new service providing "off-the-shelf" computer programs for utilities to enable them "to get their computers on the air at sharply reduced costs." Another is the Stretch computer, claimed to be the fastest, most powerful and versatile computer in the world (right). A third development is the Tractor, a computer tape system.

### 'Off-the-Shelf' Service

The IBM off-the-shelf service offers a wide range of pre-tested computer programs, each designed to handle a major data-processing function common to all firms within a specific industry. These programs are available through the company's new Programmed Applications Library. For utilities, there is a customer billing and accounting program written specifically for the 7070-1401 data-processing system now available.

Programs in the library service will perform up to 80% of the computer user's particular data-processing operations without modification. Each program will include program instructions, block diagrams and the problem definition. The customer will have to make only limited additions or modifications to about 20% of the program to complete it to meet his specifications.

Each program will be a composite of industry and IBM experience, utilizing standard programs and coding systems already available for IBM computers, in accepted machine language for the computer used.

IBM points out that a utility using this program will be able to start its billing and accounting operations months, possibly even a year, earlier. Other features are reduced 7070 installation costs, improved customer service, increased control, more streamlined operations and faster data-processing.

### Stretch Computer

The Stretch class of large-scale computer is suitable for very large mathematical problems or for simulating an entire electric utility operation, necessary in studying the optimum expansion plans for generation, transmission, and possibly even distribution. Computers are solid-state machines. They will be marketed in a price range upwards of $10,000,000 on a special basis under which the principal element of the system will be offered for purchase only, while other components will be offered for either purchase or monthly lease. Stretch computers will be used for business data processing, as well as scientific computing.

IBM will now contract with business firms and government agencies to build Stretch type computers. Firms using them, says IBM, can complete 100 billion computations in a day. Seventy-five times faster than the large-scale IBM 704 computer, the new machines occupy no more floor space. They perform more computations per dollar than any other system in the world. Stretch technology makes it possible for the first time, IBM points out, to make a complete mathematical model of a corporation's operations, showing how various management decisions would affect these operations. Well over 1,000,000 logical operations per sec can be performed by the arithmetic unit.

### Tractor Tape System

The third new IBM development, the Tractor magnetic tape system, is 24 times faster than those used on present large-scale IBM computers. Information may be read from or written on the tape at a rate of 1,500,000 characters per sec. Its tape reels will store 60 billion characters. This system could be used by a utility in transferring data by telephone or telegraph line from one location to another.

The Tractor tape system, fully automatic, can manipulate as many as 640 sealed cartridges holding 220 miles of magnetic tape. These cartridges are brought into position automatically by the computer for magnetic reading and writing. Tractor tape system sells for $55,500.

(*More News of Manufacturers, p* 102)

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Effective! Reliable! Economical!

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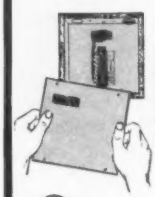
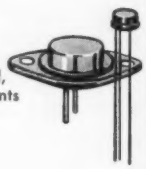


② Plug-in units provide ease of installation, expansion and maintenance.



③ Transistors and rugged, industrial type components used throughout.

④ Central control cabinet, costly engineering and fabrication eliminated.

Wherever a highly dependable, voice communication system for use in high noise level areas is needed—you'll find GAI-TRONICS specified by name.

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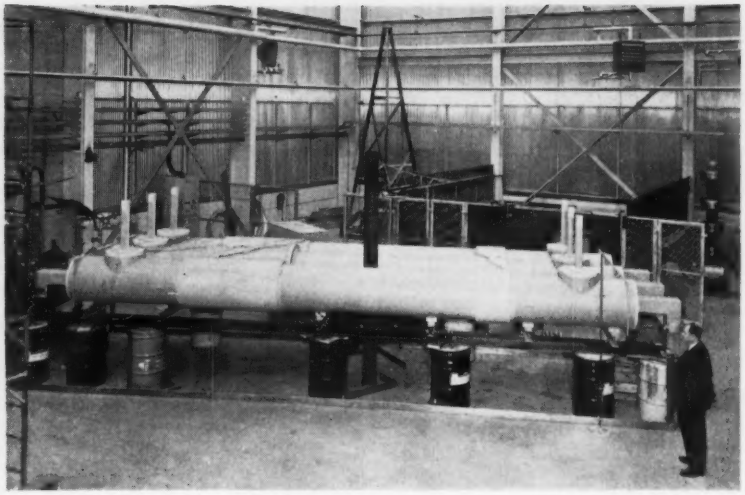


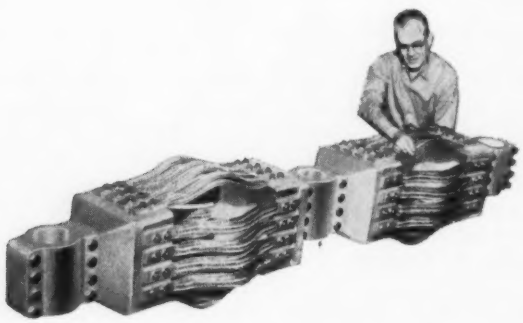
## New GE Bus Used by Pacific G&E

Pacific Gas & Electric is the first utility to use General Electric's new isolated-phase bus, shown (above) undergoing heat-run tests at GE's h-v switchgear laboratory. Supplied as a self-cooled pressurized unit for Pacific Gas & Electric's Pittsburg station, it is also available with forced-cooling or for 105F operation.

The bus design, labelled by GE as "radically new," utilizes a recently-developed method of enclosure shielding to eliminate induced current in adjacent steel structures, significantly reducing hysteresis and eddy-current losses.

Design principle is that current flowing in one direction in a conductor and in the opposite direction in an enclosure produces practically no external flux. Laboratory tests indicate 90% less external flux results, compared to unshielded conductors.

By connecting the ends of a 3-phase bus enclosure, and with proper proportioning of diameter and thickness, a closed circuit for induced circulating currents is created.



## 'Largest' Flexible Connector Shipped

The 10-000-amp, flexible braid connector (above) shipped to Allis-Chalmers recently by Penn-Union Electric Corp will connect neutrals of a 282-Mva, 20-kv steam turbine-generator. Weighing 700 lb and 8 ft long, it is the largest the connector manufacturer has ever produced.

Three 6-in. silver-plated copper-alloy stud connectors use 32 double-braid connectors for joining. Generator studs are on 42-in. nominal centers with ±½-in. movement.

(*More News of Manufacturers p* 104)

Photograph courtesy of Casco Products Corporation, Coated fabric by Aldan Rubber Co.

# ENJAY BUTYL

## boosts quality in heating pads . . . 1001 other products

The Enjay Butyl coating on the protective envelope of this heating pad boosts quality in some very practical ways...

- Butyl coated fabric retains its flexibility . . . conforms easily to body contours and movements.
- Butyl coated fabric is impermeable to moisture...protects delicate electrical parts.
- Butyl coated fabric is tough and pliable...resists tearing, cracking and stiffening.
- Butyl coated fabric is highly heat resistant...can be steam sterilized.
- Butyl coated fabric is chemically inert...needs no special treatment to resist attack by perspiration and bacteria.
- Butyl coated fabric heating pads have UL approval...have had it for 10 years.

In more than 1000 other appliances and places, Enjay Butyl delivers an unmatched combination of good properties. Resists heat, moisture and pressure in clothes washer door gaskets...provides outstanding arc resistance in bus bar and cable insulation...stands up to ozone, sunlight, weathering in garden hose and window sealing. Butyl coatings add years of service life to worn asphalt shingles!

*For complete information, write or phone the nearest Enjay office.*

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## Westinghouse Will Build 265-Mw Steam T-G Unit

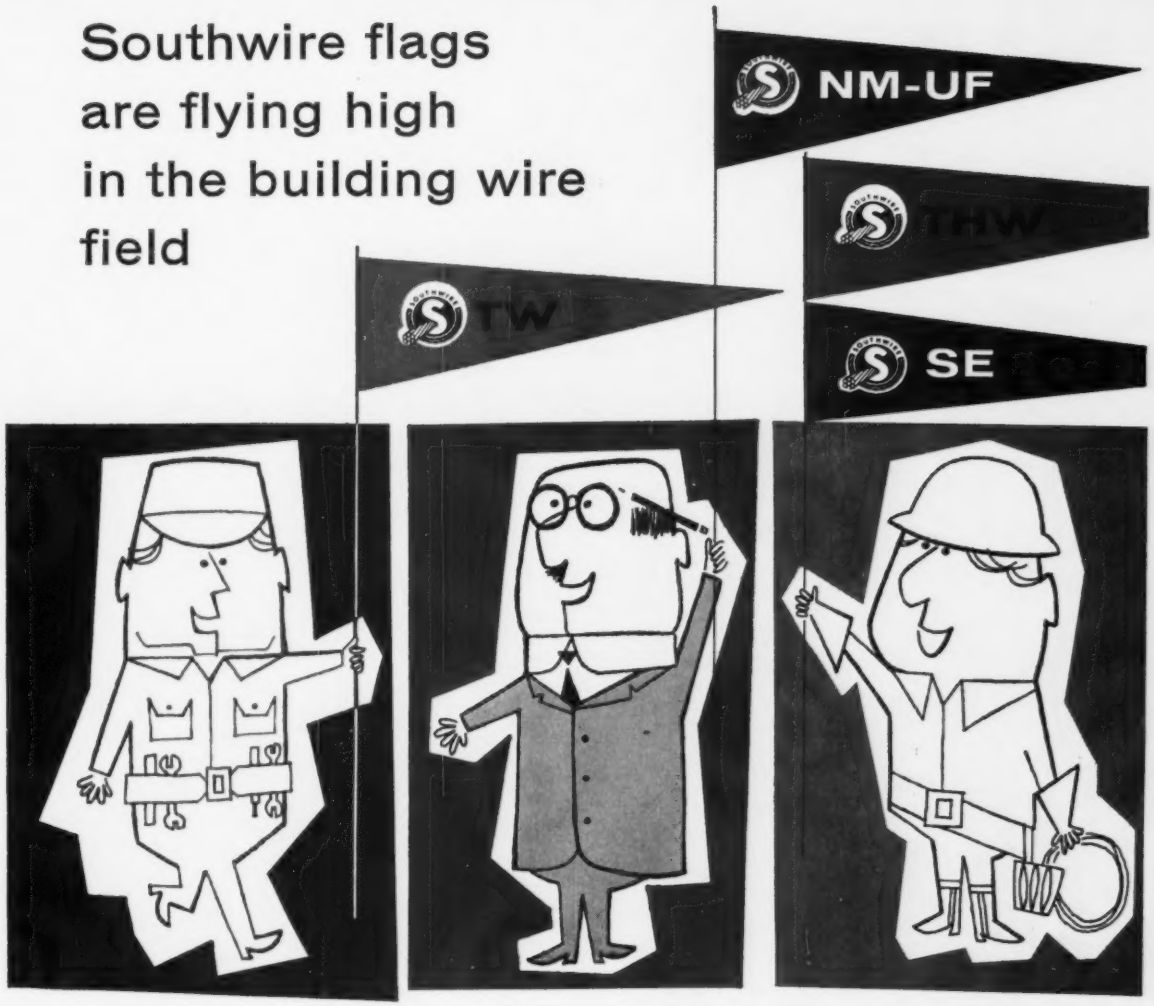
Westinghouse Electric will build a 265-Mw steam turbine-generator unit for Kentucky Power Co's Big Sandy plant, a $39-million project which will be located near Louisa, Ky. The 2,400 psi, 1,050F steam turbine will be manufactured at the Westinghouse steam division at Lester, Pa., and the generator at the East Pittsburgh plant.

The new plant will be interconnected and integrated with the other 15 major power stations of the seven-state American Electric Power Company system, of which Kentucky Power is an operating company subsidiary. Construction will start in June and completion is scheduled for the fall of 1962. It is estimated that ¾ million tons of coal per year will be burned by the plant.

## MANUFACTURERS BRIEFS

**General Electric** has announced trade-in allowance of up to $3500 for installation of the company's new turbine supervisory instrument systems . . . Preliminary approval of merger of **Emerson Electric** and **Day-Brite Lighting** is given by both companies' boards of directors. Final approval is expected shortly. Under the plan, both companies will retain their present identity, management and products, but Day-Brite will become a subsidiary of Emerson . . . **Eisler Transformer** of Dover, N. J. acquires **Harrison Transformer** of Springfield, N. J. John Fernicola, ex-head of Harrison, becomes vice president and general manager in charge of all Eisler operations. Manufacturer of power transformers up to 2500 kva is anticipated "in the near future" . . . **Allis-Chalmers** receives letter of intent from the Italian National Committee for Nuclear Research (CNRN) authorizing A-G to undertake work in the uranium thorium fuel cycle development program for power reactor systems . . . **Okonite,** Kennecott Copper subsidiary, reports a loss for the year of 1959, accounted for by demand concentrated in "highly competitive products." Product volume dropped 3%. (*More Procurement & Products p* 109)

# Southwire flags are flying high in the building wire field




**COMPLETE LINE—FULL RANGE OF SIZES—ALL UL APPROVED**

(Also available: MACHINE TOOL & APPLIANCE WIRE, FIXTURE WIRE, TELEPHONE WIRE)

In the warehouse or on the job, Southwire building wire is preferred because it is top quality wire that is extra easy to handle. It is manufactured to National Electrical Code specifications and packaged with the folks in mind who sell and use it. Order any of these quality Southwire products and get fast Southwire deliveries — direct by our own trucks.

- Bare and Weatherproof Copper and Aluminum Line Wire
- Neoprene, Polyethylene, and VWP* (Vinyl) Weatherproof Copper, Aluminum and Triplex
- U.R.C. (DBWP, TBWP) Copper
- Copperweld® Conductors
- Copper and Aluminum Building Wire
- ACSR and All Aluminum Cable
- Galvanized Steel Guy Strand and Static Wire
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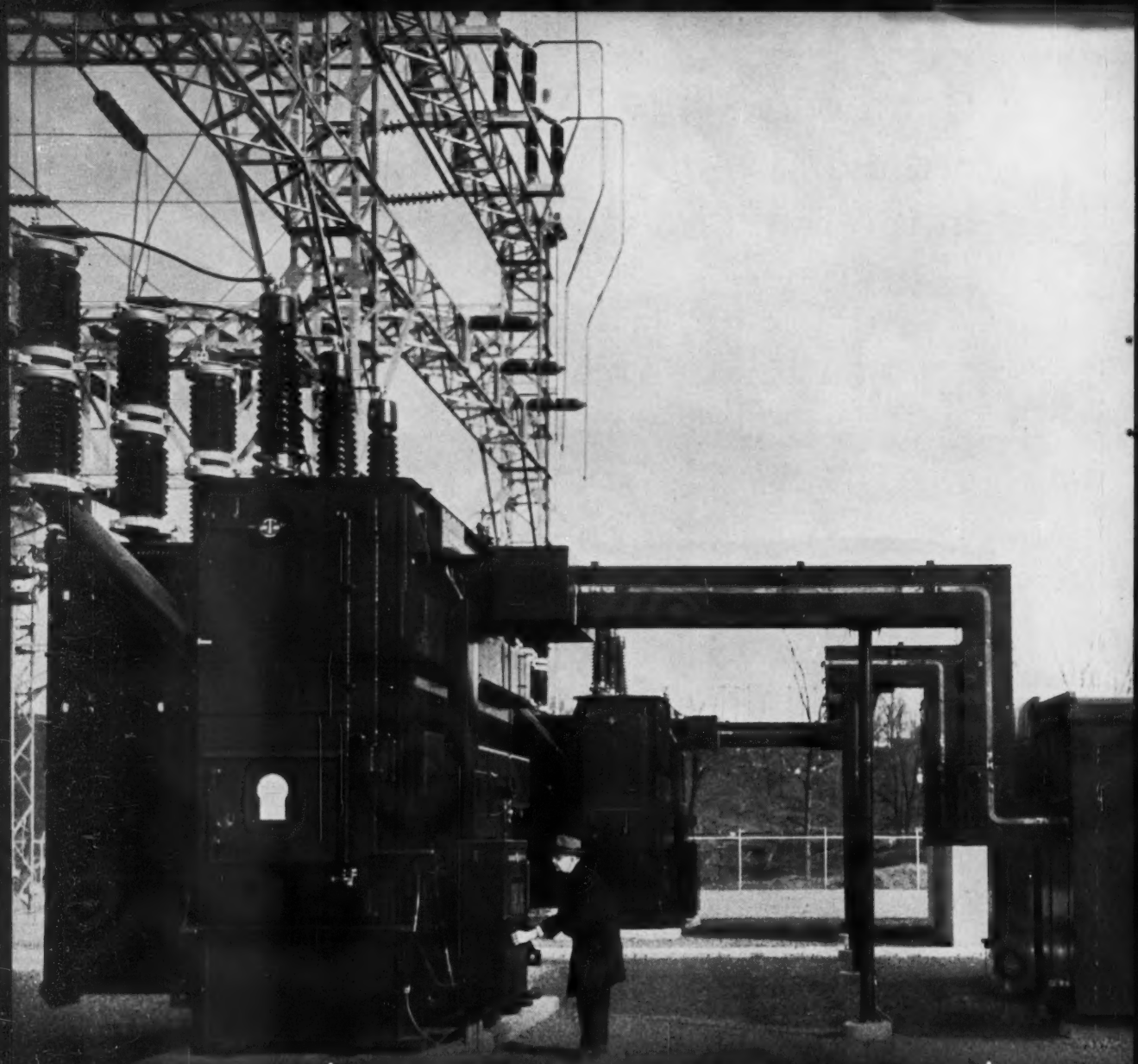
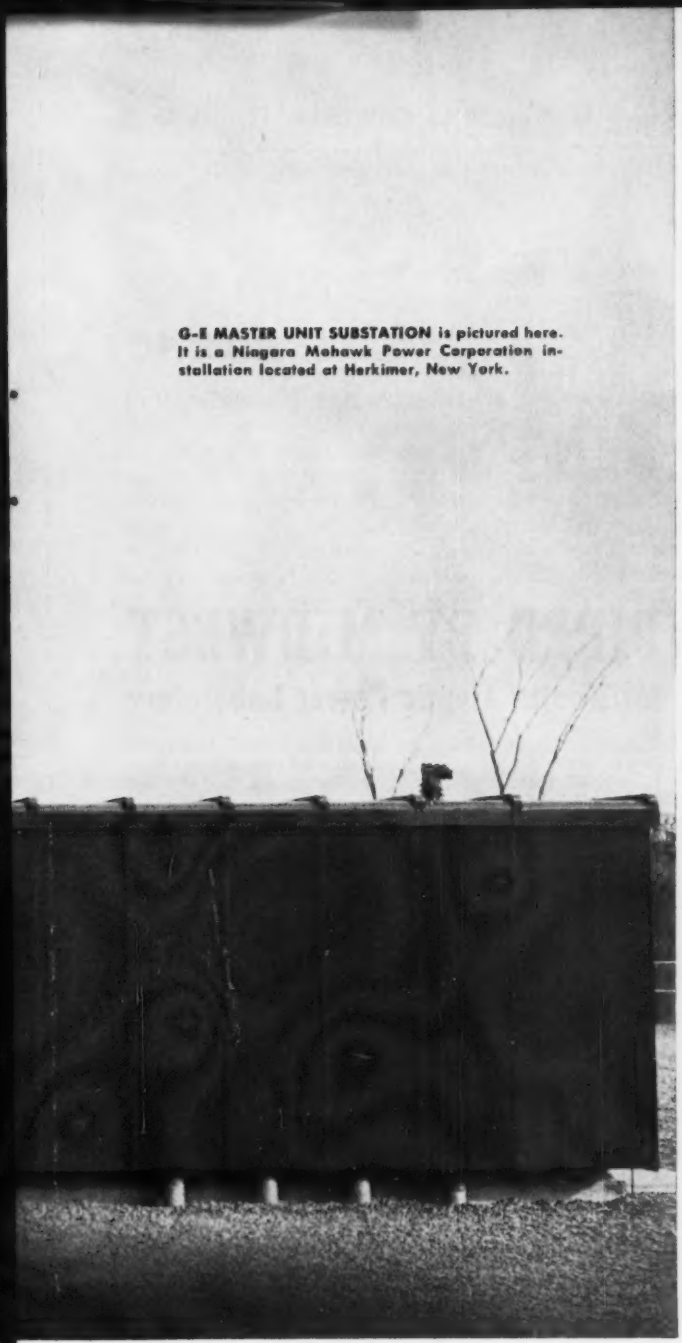


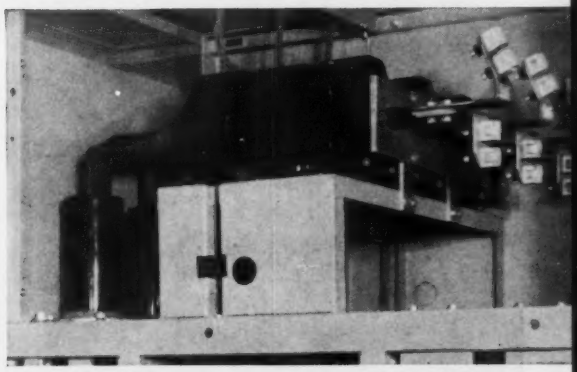
*if you need* **SYSTEM RELIABILITY** *you need...*

# COORDINATED General Electric Master Unit Substations



**G-E MASTER UNIT SUBSTATION** is pictured here. It is a Niagara Mohawk Power Corporation installation located at Herkimer, New York.

**COORDINATED** manufacturing skill, developed through years of pioneering in the electrical industry, is a vital ingredient of every G-E master unit substation.



**COORDINATED** components such as butyl-molded current (shown above) and potential transformers are another key to improved station performance.

**COORDINATED** testing at modern switchgear and transformer laboratories helps assure coordinated master unit substations, designed for top system reliability.

Today, system reliability is a frame of reference against which other considerations—price, delivery, installation—must be placed when distribution equipment is involved.

At General Electric, the challenge of increased system reliability is being met by designing completely coordinated master unit substations to fit individual system requirements.

This coordination takes many forms:

- **Coordinated Manufacturing Skills** mean that transformers, switchgear and other components are engineered by experts; manufactured by craftsmen for top system reliability.
- **Coordinated Components,** specifically designed to complement each other, afford more reliable transformation and fault current protection.
- **Coordinated Design Testing** puts all master unit substation components through their paces under duplicated field conditions.

When you evaluate your substation plans, be sure to consider reliability inherent in system coordinated G-E master unit substations. For more information contact your G-E Apparatus Sales Office or write for bulletins GEA-3800D and GED-4052, General Electric, Schenectady 5, N. Y. 512-33

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### for Knolls Atomic Power Laboratory

Through this project . . . an important "first" in atomic power development . . . Midwest proved conclusively that heavywall Inconel piping can be fabricated and erected to meet the most stringent requirements.

Designed for testing materials and components of pressurized water reactors, this loop was fabricated by Midwest's St. Louis plant from Midwest-manufactured Inconel pipe and fittings, 10¾″ O. D. with a wall thickness of 1″. Other Inconel and stainless welding fittings and pipe, Inconel socket welding fittings and Inconel butterfly valves were also manufactured by Midwest.

Erection of the time- and money-saving prefabricated Inconel piping—all auxiliary piping, the complete electrical power and control system and instruments—was handled entirely by Midwest's competent field erection department.

For complete service . . . welding fittings, shop fabricated piping, and erection service . . . CONTACT MIDWEST.



Write for NEW 20-page bulletin—CRITICAL PIPING FOR THE NUCLEAR AGE—describing Midwest's nuclear experience.

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**MIDWEST PIPING COMPANY, INC.**

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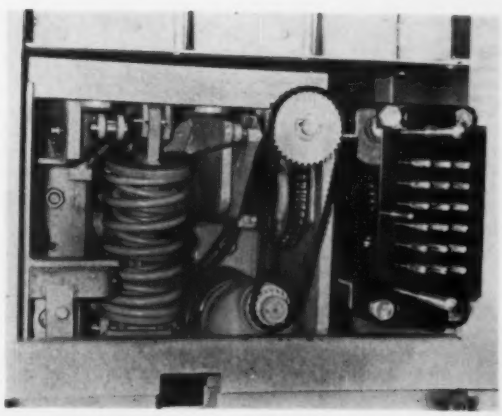
(For further information refer to Readers Service on page 119)

## EDP System . . .

**. . . has modular design,** which lets the user start with a modest system and expand it as necessary. Because the 601 uses the universal computer language, it is compatible with other computers. In parallel processing and control operations, it works on a job priority basis and can handle changeable priorities. Smaller transistorized 301, which offers either a magnetic tape memory or the "juke box" type shown, handles linear programming and matrix operations for engineering computations.
**Radio Corp of America, 30 Rockefeller Plaza, New York 20, N. Y.**

## Disconnect Switch . . .

**. . . has braidless terminal hinge contacts.** The side-break RJ-2, rated 69 kv heavy duty to 230 kv and 600-2,000 amp, is for sectionalizing transmission lines, isolating power circuit breakers and opening primaries of transformer banks. Insulator stacks rotate to open magnetic loop type, silver-to-silver contacts. Mounting can be horizontal, underhung, or, without arcing horns, vertical.
**General Electric Co, Schenectady 5, N. Y.**

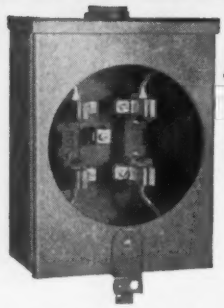


## Stored-Energy . . .

**. . . spring mechanism closes and opens breaker,** and permits outside power source to be eliminated. The device for 5 and 15-kv DST magnetic air circuit breakers is charged either manually by the single downward stroke of a handle or by a small electric motor. Recharging time using the latter is fast enough to meet the standard 5-sec duty cycle.
**Federal Pacific Electric Co, 50 Paris St, Newark 1, N. J.**

(*More New Equipment on page* 110)

Look to Superior for
SOCKET EQUIPMENT



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NEW 3/4-ton
Pull-A-Way
Added to WRIGHT
TYPE "C" LINE!

FOUR SIZES • ¾, 1½, 3 and 6 Tons

FEATURES
• Lubricated for life
• Hooks are drop-forged
• Special alloy-steel chains
• Chain sheaves of drop-forged alloy steel
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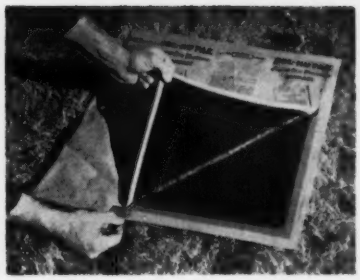
¾-ton, 14 lbs.
1½-ton, 23½ lbs.
3-ton, 36½ lbs.
6-ton, 63 lbs.

New 3/4-ton model
• VERSATILE
• LIGHTWEIGHT

ACCO

Write to York, Pa., office for complete information

Wright Hoist Division
AMERICAN CHAIN & CABLE
York, Pa., Bridgeport, Conn.

## Preservative Bandage . . .

**. . . for ground-line treatment** of standing poles has a deep-penetrating grease preservative. Pol-Nu Pak can be carried along on a line truck for application when needed. It requires only 18 in. excavation and is stapled to the pole. Four lengths from 27 to 48 in. fit the commonest pole diameters.
**Chapman Chemical Co, Box 138, Memphis 1, Tenn.**

## Pulling Eye . . .

**. . . is used as a temporary eye** or for installing prefabricated guy grips. The Pengo E-90B bushing fits on anchor rods from ½ to 1¼ in. dia.
**Petersen Engineering Co, Inc, Santa Clara, Calif.**

## Digital Readout . . .

**. . . of temperature and pressure** is provided by system with accuracy of ½% to 2%. Ranges are 0-1,400F and 0-10,000 psi. The system also encodes for telemetering. As many as 99 different points can be monitored.
**Texas Instruments Inc, 3609 Buffalo Speedway, Houston 6, Texas.**

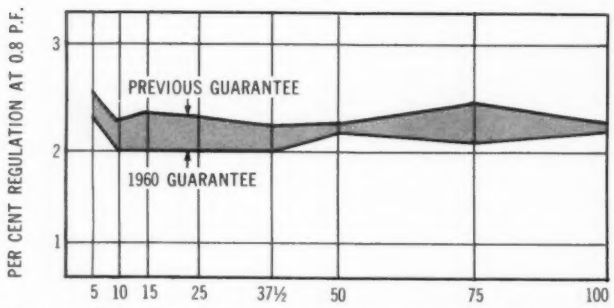
(*More New Equipment on page* 115)

# ALL NEW core and coil saves revenue dollars

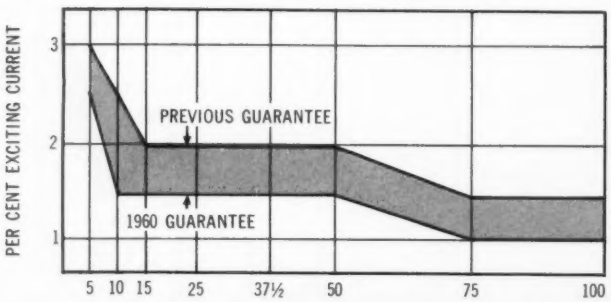
The new Kuhlman designs guarantee lower exciting current . . . improved regulation in all popular ratings . . . higher margin of safety . . . better impulse characteristics . . . and an all-over reduction in size and weight.

The new designs take full advantage of the inherent characteristics of modern electrical materials to achieve the highest efficiency and lowest losses.

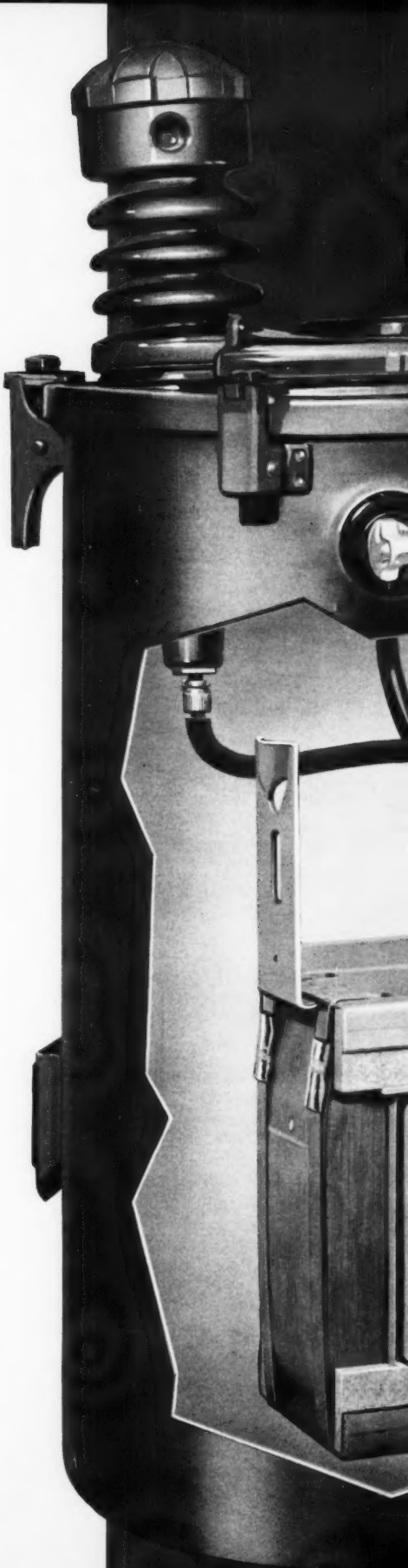
In every day operation this means better voltage regulation for the customer . . . more revenue per transformer . . . smaller, lighter, more efficient units with improved economy.

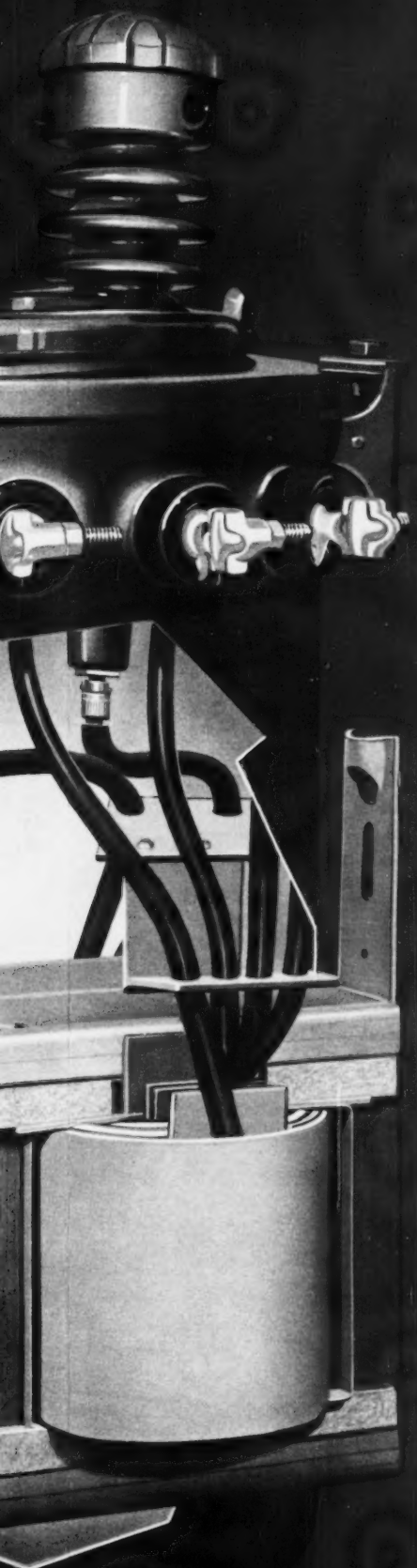



*Better voltage regulation for customer service—Chart shows the area of improved regulation covers all popular ratings.*




*Lower distribution costs per transformer—Guaranteed exciting current is lower than previous guarantees in all popular sizes.*



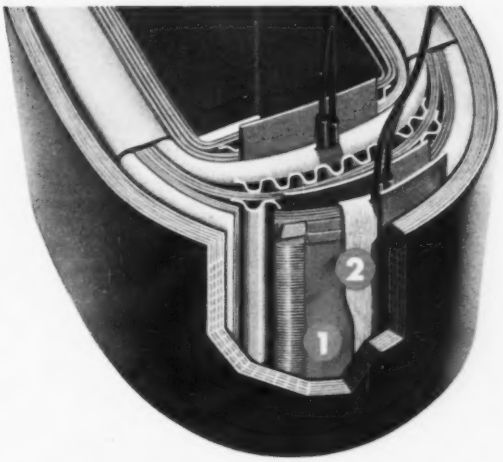


# ALL NEW coil cuts transformer weight and size

New Kuhlman designs put more transformer per pound on the pole, with the same low losses and performance of heavier designs.

A newly developed equalizing shield more equally distributes impulse voltage stress (**1**) so that no portion of the winding is subjected to a marked, disproportionate share of the surge voltage.

Special insulation (**2**) is wound into the winding to provide puncture as well as creep insulation values. The combination of shield and insulation results in a more compact coil and a general reduction in all-over size and weight.




# ALL NEW construction improves performance and mechanical strength

New construction, top to bottom, offers several important improvements. The core is smaller, with fewer and shorter gaps spaced for minimum local flux concentration. Coil construction offers compactness, improved impulse voltage distribution characteristics and higher margins of safety.

Thermosetting insulation bonds the coil into a tight, compact unit. The improved core clamp gives added mechanical strength to the core and coil assembly.

**KUHLMAN TRANSFORMERS**

*Manufacturers of transformers since 1894*

**KUHLMAN ELECTRIC COMPANY, Birmingham, Michigan**

**Factories: Bay City, Mich.; Crystal Springs, Miss.; Salinas, Calif.**

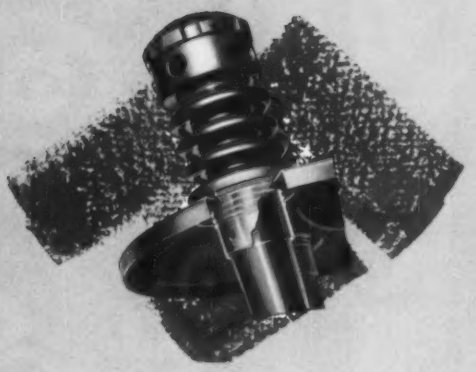
*the*

# KUHLMAN '60

**all new outside...**

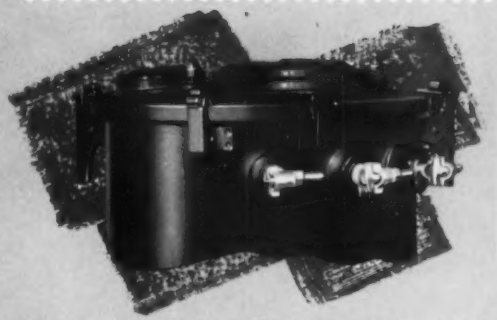
**...all new inside**

# ALL NEW outside



## *New interference-free High Voltage bushings*

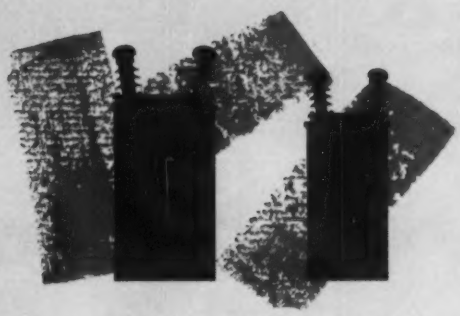
New "Quick-Grip" is an oil-less bushing with a stress relieving ground sleeve for positive reduction of radio interference. The bushing also features: a protective hand grip for simpler line connections . . . internal clamping . . . and protection against service interruptions caused by wild life.



## *New cellulosic coated cover*

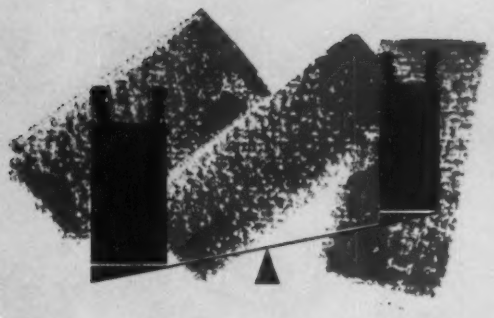
Kuhlman "Celuclad" covers are standard on all new pole-mounted designs.

The new cellulosic cover is durable, has excellent weathering and dielectric qualities, gives added protection against outages caused by birds and squirrels.



## *Smaller, trimmer tank*

New Kuhlman designs come in smaller tanks and take less room on the pole. For example, 25 KVA 7200 volt class now measures only 36 inches including cover mounted bushings: the 37½ KVA is only 43 inches. The shorter units allow more clearance for uprating transformers on existing structures.



## *More transformer per pound*

The trimmed down, lighter Kuhlman '60 puts more transformer per pound on the pole—more performance into a smaller package—eliminates needless weight.

Compare the new compact Kuhlman with the heavier units you are now using. You'll see how, pound for pound, Kuhlman gives you more performance.

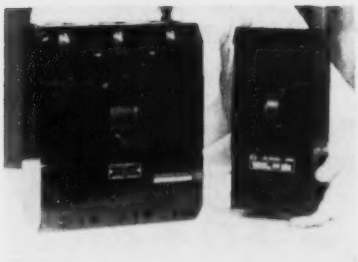
**KUHLMAN TRANSFORMERS**

*Manufacturers of transformers since 1894*

**KUHLMAN ELECTRIC COMPANY, Birmingham, Michigan**

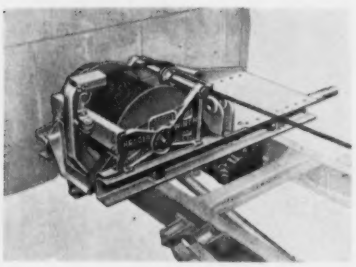
**Factories: Bay City, Mich.; Crystal Springs, Miss.; Salinas, Calif.**

Litho in U. S. A



## Circuit Breaker . . .

**. . . is exactly half as wide** as the earlier type shown. The FJ-frame molded case breaker provides the ratings of the larger F-frame in a case 1 in. shorter than the F-frame and 4½ in. wide. Both are $4\frac{1}{16}$ in. deep to fit the same panelboards. FJ-frame breakers are available from 70 to 225 amp, 600 v ac and 250 v dc, in 2 and 3-pole units.
**I-T-E Circuit Breaker Co, Philadelphia, Pa.**



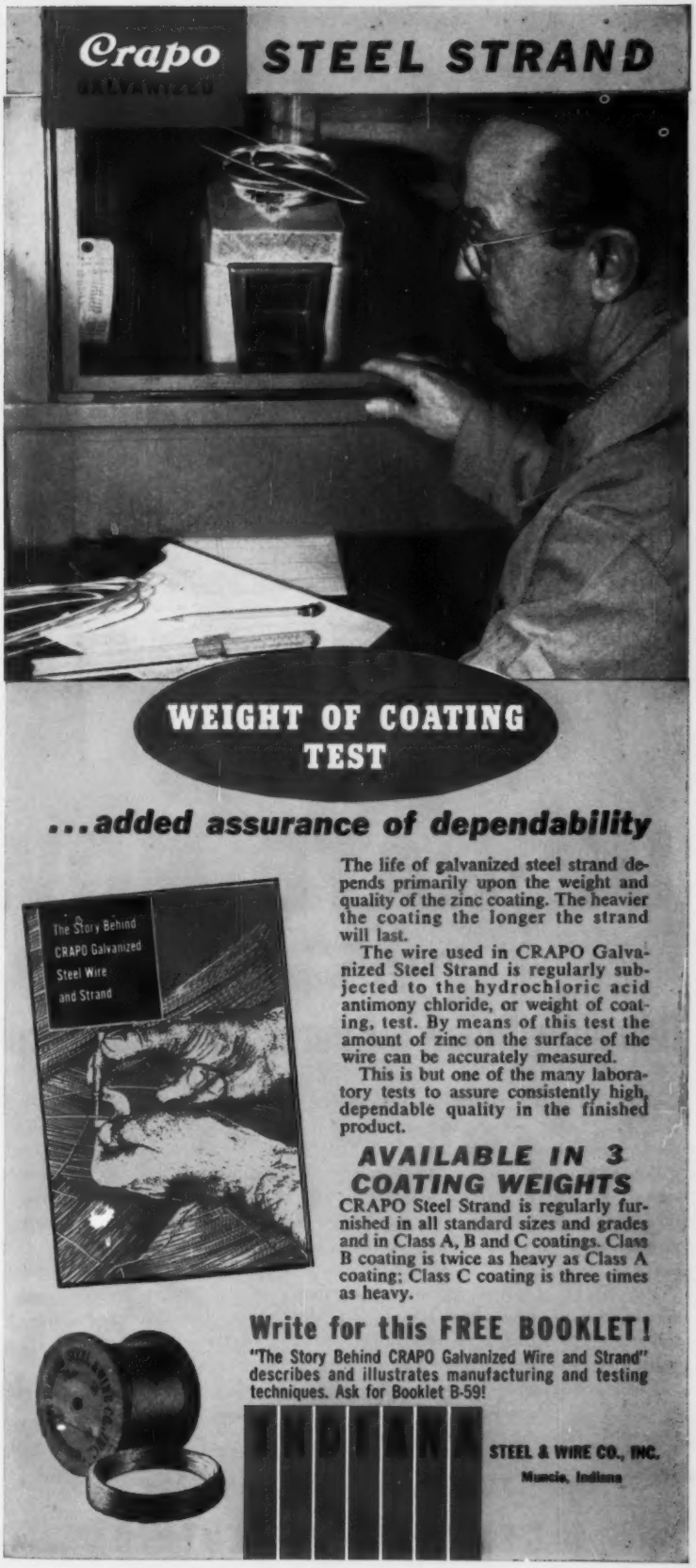
## Hydraulic Winch . . .

**. . . for one-man operation** has separate drums for pulling and for taking up cable. Since there is no build-up of cable layers on the power drum, model CL hauls a conconstant load with constant speed. It is rated at 12,000 lb. Hydraulic control varies speed within each of three speed ranges.
**Braden Winch Div, Motor Products Corp, Broken Arrow, Okla.**

## Wheel Tractor . . .

**. . . loads 2,500 lb** and digs 3,000 lb as a backhoe. The 52-hp, gasoline-powered Model W-3 drives through a hydraulic torque-converter, which transmits greater push power than geared drive with

(*Continued on page* 116)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# UP-RATE NOW

## to 55°◉65°

## Rebuild with new G-E Permalex* core and coils

Now, rebuild distribution transformers to take advantage of 55° ◉ 65° dual-kva ratings—today's most modern transformer development. An old 5-kva unit housed in a 12-inch diameter tank, for instance, can be rebuilt to a basic rating of 15 kva. Additionally, General Electric 55° ◉ 65° dual-kva units give you 12 percent more kva with a supplementary rating—based on 65C peak load temperature rise. After rebuilding with G-E Permalex core and coils, your transformers are rated at 16.8 kva—a total increase of 335 percent.

Rebuilt distribution transformers offer you real dollar savings plus new reliability with a new transformer warranty. Have your obsolete or burned-out units rebuilt by one of General Electric's 55 Apparatus Service Shops. Or have your own shop install these up-to-date G-E transformer features.

For more information see your General Electric Service Shop representative or G-E Sales Engineer. General Electric Co., Schenectady 5, N. Y. 485-02

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*Progress Is Our Most Important Product*

GENERAL ELECTRIC

### Wheel Tractor . . .

(*Continued from page* 115)

smoother operation. It also operates such attachments as crane boom, dozer, all-purpose blade, pallet forks and post-hole digger.
**J. I. Case Co, Racine, Wis.**

### Thermostats . . .

**. . . for battery protection** against high temperature damage and low temperature inefficiency are available in a range of models to operate at temperatures from —65F to 150F. Battery Immersion Thermostat contacts have a snap action, make or break, as desired.
**D. W. Onan & Sons Inc, 2515 University Ave SE, Minneapolis 14, Minn.**

### Cold-Cleaning Solvent . . .

**. . . for electrical equipment** can be used repeatedly through reclamation in standard distillation units. Chlorothene NU solvent removes oils, waxes and lubricating compounds by dipping or wiping, and leaves little or no residue.
**Dow Chemical Co, Midland, Mich.**

(*More New Equipment on page* 119)

# LOW COST

## REYNOLDS 5005

### high strength, all-aluminum conductor

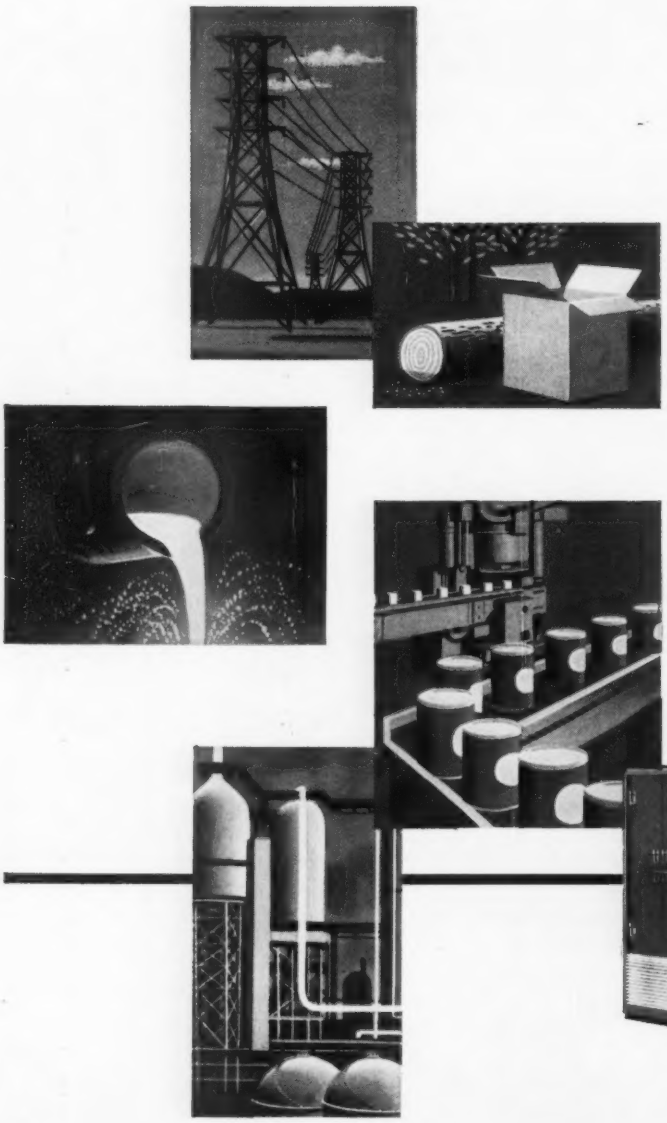
*Reynolds 5005 costs less than any other conductor with comparable properties.* You get lower power losses . . . Improved voltage regulation . . . increased current carrying capacity. Minimum guaranteed conductivity 53.5%. And 5005 is also light in weight—stringing and handling costs are lower. It has no steel core, thus is easy to splice and there is no chance of galvanic corrosion. Complete data available from your nearest Reynolds branch office, Reynolds Electrical Distributor, or *Reynolds Metals Company, P. O. Box 2346-EL, Richmond 18, Virginia.*

Watch Reynolds TV shows: "BOURBON STREET BEAT", "ADVENTURES IN PARADISE" and "ALL STAR GOLF" (resuming in October)—ABC-TV

*NOW... a new, powerful electronic system to automatically monitor and control your industrial processes*

# THE RCA 110

## INDUSTRIAL COMPUTER SYSTEM



Designed by RCA for modern industrial control of all major industries, the RCA 110 provides unprecedented capabilities for off-line and on-line data accumulation, and for real time automatic control of industrial systems. For applications as diversified as economic distribution and generation of electrical power for public utilities, systematic production control in the metal working industry, on-line control of entire petrochemical plants, the RCA 110 is universally adept.

The RCA 110 Industrial Computer System offers efficient and highly advanced concepts of automated process control for maximum payout in modern industrial applications. The RCA 110 is also available with instrumentation by the Foxboro Company. For detailed information, contact your local Foxboro representative or write to: Industrial Computer Systems, Electronic Data Processing Division, Radio Corporation of America, Camden 2, New Jersey.

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Nationwide RCA service organization gives unexcelled customer assistance to 110 Industrial Computer users.

*NEW*

# RCA 110

## INDUSTRIAL COMPUTER SYSTEM

**RCA, with the experience gained as a major supplier of *electronic data processing* systems for business, originates a truly modern computer system for industry. Here are the features that bring you unlimited potential for process control progress.**

***NOW*** — virtually unlimited number of analog or on-off inputs plus a wide variety of conventional input/output equipment can be integrated with the computer for complete system flexibility

***NOW*** — automatic program interrupt by which control points can "on demand" take over the computer for instantaneous handling of critical tolerances or safety factors

***NOW*** — computer logic accepts decimal or binary information; powerful instruction code provides complete flexibility including automatic priority handling of control functions

***NOW*** — high speed computation, with fast random access core memory in combination with 3600 rpm memory drums, results in highly effective overall system speed

***NOW*** — expansibility, in natural stages of process-control development, economically implemented by "building block" concept

***NOW*** — all transistor, printed circuit construction assures highest reliability. Diagnostic routines for self-checking, *during operation*

***NOW*** — easy maintenance with plug-in components and slide-out sub-assembly drawers. Serviceable during operation. Rugged, heavy-duty construction; cabinet may be pressurized. Does not require external air conditioning.

The Most Trusted Name in Electronics

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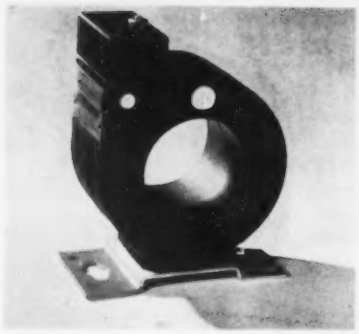
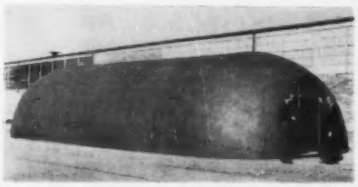


### Current Transformer . . .

**. . . for indoor and outdoor metering** accommodates two 750-MCM or three 500-MCM insulated cables. Current ratings are 200:5, 400:5, 600:5 and 800:5 amp. Type TWM is insulated with epoxy resin for 600 v. Primary and secondary pole markings are permanently cast in the transformer.
**Allis-Chalmers Mfg Co, Milwaukee 1, Wis.**

### Fiberglass Shelter . . .

**. . . usable as temporary warehouse** or shop is 50 ft long. Four men can erect the transportable shelter in an hour and dismantle it in ten minutes. It is weathertight and lightproof and



can be air conditioned or heated by portable units. Smaller structures from 20 ft long are also available.
**Specialty Electronics Development Corp, Syosset, N. Y.**

### Detector . . .

**. . . gives warning** when monitored inputs exceed or drop below selected values. The device, with solid-state circuits and Magsense detector, handles a variety of low-voltage and small-current inputs, which can also be combined to actuate a single

(*Continued on page* 120)

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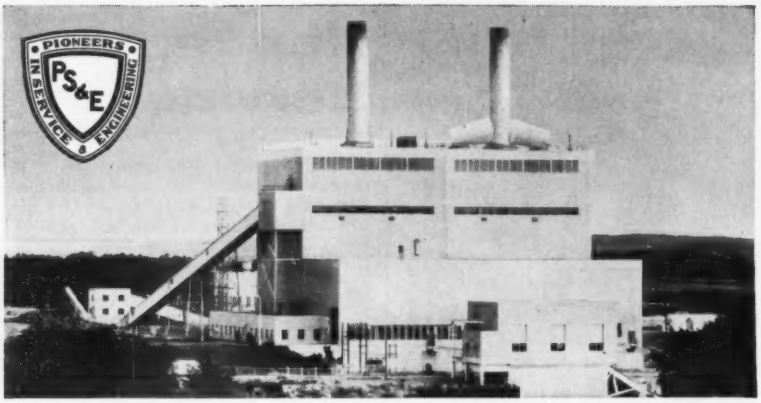
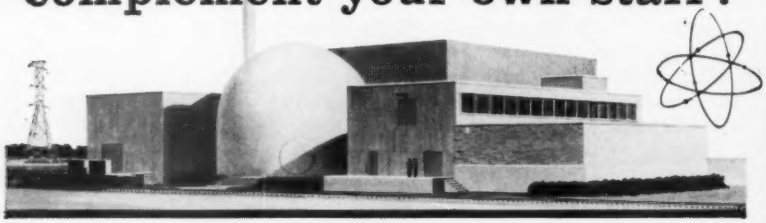
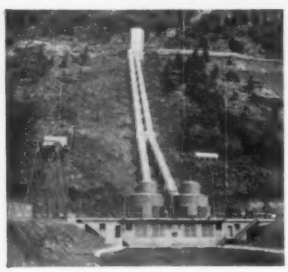
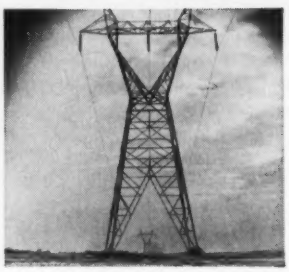
**MAY 16, 1960**




**Which Pioneer service do you need to complement your own staff?**







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Pioneer specializes in designing power plants and offers design service for fossil fuel, hydro and atomic plants. It will also assist in forecasting load growth, in site selection, in purchasing and expediting of equipment and construction management. Pioneer's other services include substation, transmission and distribution studies and design.

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Pioneer offers its services as business and management consultants; stock transfer and dividend disbursing agents; financial, accounting and tax consultants.

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*Serving Electric Utilities and Industrial Power Users Since 1902*

**Pioneer Service & Engineering Co.**

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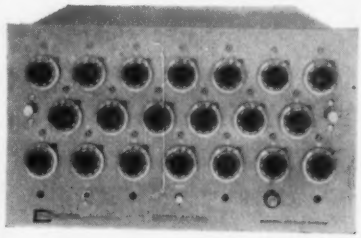
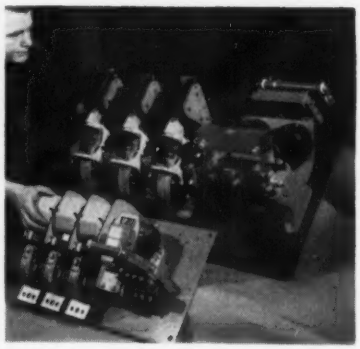
## Detector . . .

(*Continued from page* 119)



point. Abnormal condition causes an identification lamp to light and contacts for an alarm to close.
**Control Systems Div, Daystrom, Inc, La Jolla, Calif.**



## Ac Contactor . . .

**. . . is about half the size** of the prior model. The ac operating magnet will pull in the contactor at 85% to 110% of rated 600 v. A permanent air gap insures dropout on de-energizing. Moving armature of the type GP contactor is flexibly supported and aligns itself on closing for good contact.
**Westinghouse Electric Corp, Box 2099, Pittsburgh, Pa.**

## Annunciators . . .

**. . . in a variety of sizes** can be furnished with integral recording apparatus as an option. Standard cabinet for the series PA annunciators measures 78 in. high, 72 in. wide and 18 in. deep. Cabinet panel face of plastic can be marked with functional system silhouette.
**Prenco Mfg Corp, 2605 W Fourteen Mile, Royal Oak, Mich.**

(*More New Equipment on page* 122)

# announcing an important development

## in low cost, hook-operated disconnect switching...

# the DS

## unmatched for...

ECONOMY—No other switch of its type offers the combination of features found in the low cost DS. You have a choice of key components to provide the precise performance characteristics to meet your switching requirements, whether on lines or in distribution substations.

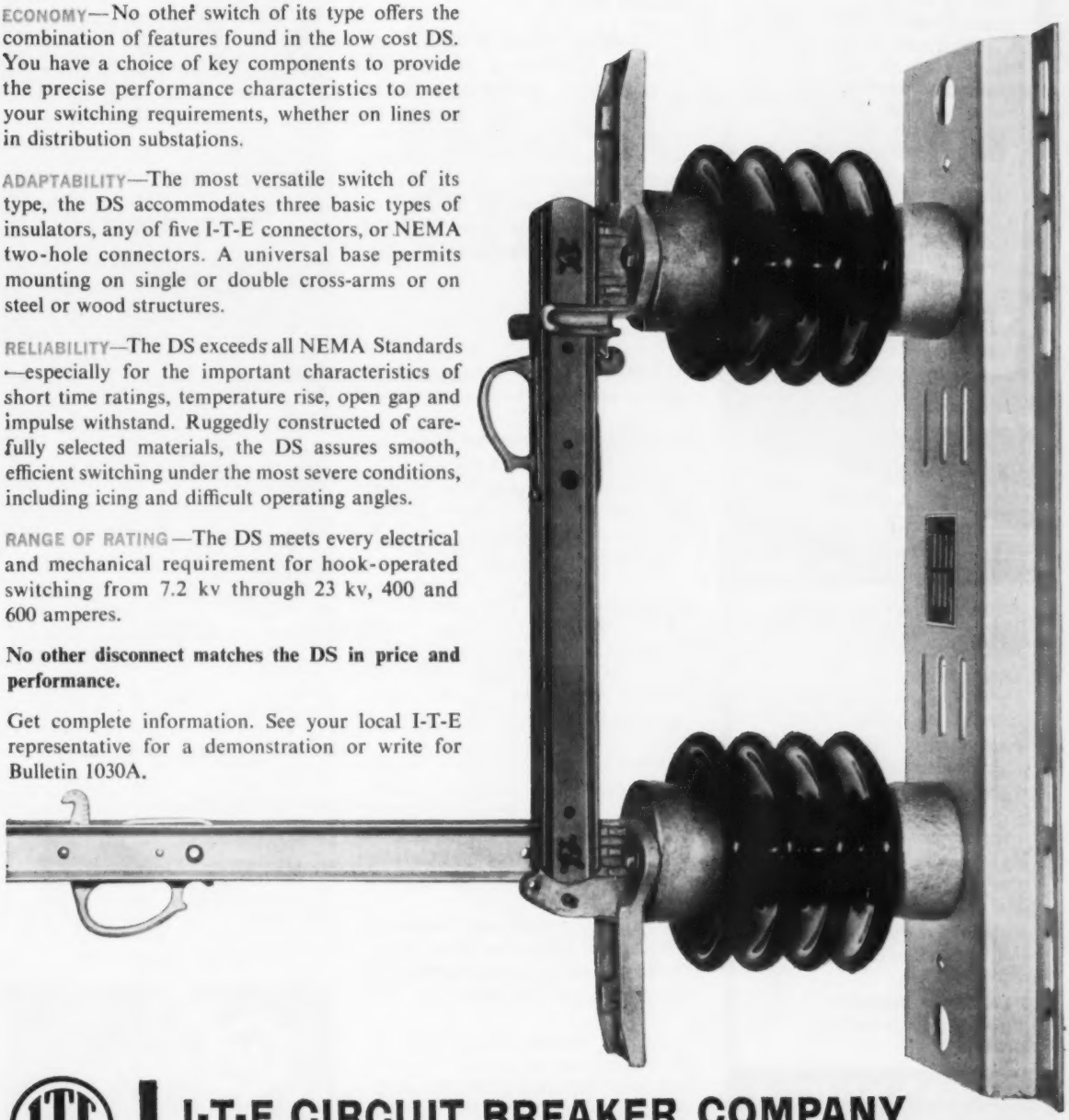
ADAPTABILITY—The most versatile switch of its type, the DS accommodates three basic types of insulators, any of five I-T-E connectors, or NEMA two-hole connectors. A universal base permits mounting on single or double cross-arms or on steel or wood structures.

RELIABILITY—The DS exceeds all NEMA Standards —especially for the important characteristics of short time ratings, temperature rise, open gap and impulse withstand. Ruggedly constructed of carefully selected materials, the DS assures smooth, efficient switching under the most severe conditions, including icing and difficult operating angles.

RANGE OF RATING—The DS meets every electrical and mechanical requirement for hook-operated switching from 7.2 kv through 23 kv, 400 and 600 amperes.

**No other disconnect matches the DS in price and performance.**

Get complete information. See your local I-T-E representative for a demonstration or write for Bulletin 1030A.



**I-T-E CIRCUIT BREAKER COMPANY**
**GREENSBURG, PENNSYLVANIA**

*Trademark

"Superformed* spells
S-A-F-E-T-Y to a
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"We Safety Men must look at any piece of equipment from the *safety* angle.

"Fanner Superforms? Sure, they are safer for our linemen to handle. Not unwieldy . . . no tools required for dead-line application . . . easily controlled with hot-line tools . . . ends are carefully machined to prevent rubber-glove puncturing . . . safer than straight wires and aluminum ribbon."

Everywhere, Safety Engineers, *the men who guard the safety of people*, have a good word for Superforms.

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"PROTECTIVE TWIST"

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**LINEGUARDS . . .**
Protect short-span T&D lines at supports

**PATCH RODS . . .**
Repair damaged conductors

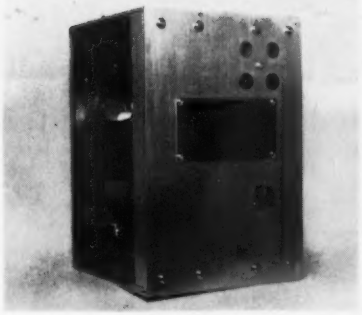
**TAP ARMOR . . .**
Protects conductor at tapping points

**FANNGRIPS . . .**
For dead-ending strands and conductors

**FANNSPLICES . . .**
Join two ends of conductor wire

**PLASTIC PRODUCTS . . .**
For conductor surface protection

FANNER
The Fanner Manufacturing Co.
Brookside Park—Cleveland 9, Ohio
Division of Textron, Inc.



## Motor Relay . . .

. . . **protects against overloads** and low or unbalanced voltages. It operates by combining heating effects of positive and negative sequence currents in weighted fashion. Automatic de-rating feature permits maximum use of motor under all conditions.
**Applied Research Associates of Texas, Inc, 6541 N Lamar, Austin, Texas.**

## *More New Products*

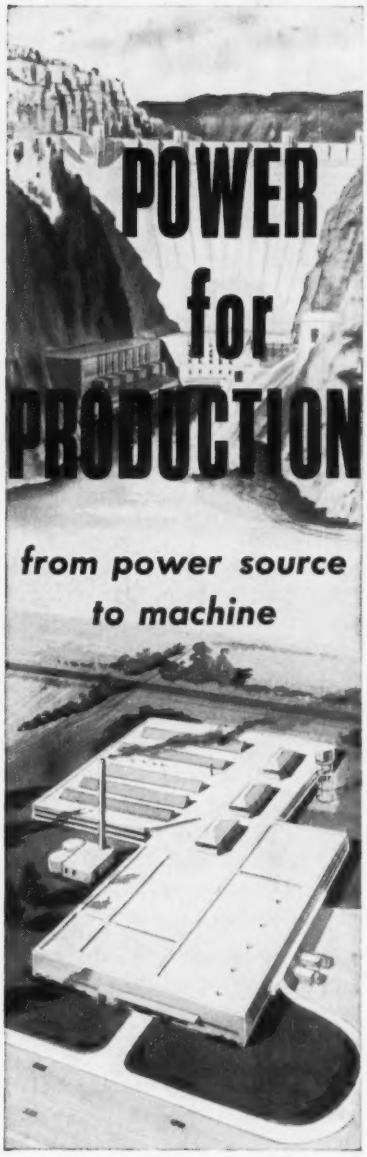
Motrac, 100-w, **two-way radio** operates in 25-54 mc frequencies. The unit accommodates either positive or negative auto battery ground polarity.—Motorola Inc, 4501 W Augusta Blvd, Chicago 51, Ill.

Automatic **welder load control** system economically prevents bad welds caused by excessive voltage drop.—W. J. Whitbeck Instrument Control Co, 1554 Nicollet Ave, Minneapolis 3, Minn.

Molded rubber, waterproof, in-line **fuse-holder kit** is available. Easily separated for fuse placement, the kit may be applied to two cable ends in minutes.—Elastic Stop Nut Corp of America, Box 38, Elizabeth 3, N. J.

Low-to-medium **pressure indicator** (Model 231 Indicating Transmitter) transmits data to remote recorder.—The Hays Corp, Michigan City, Ind.

Ultrasonic **solvent cleaner** (No. 6) for rapid removal of flux residues combines improved cavitation properties with excellent stability.—Hi-Grade Alloy Corp, 3034 E 95 St, Chicago 17, Ill.

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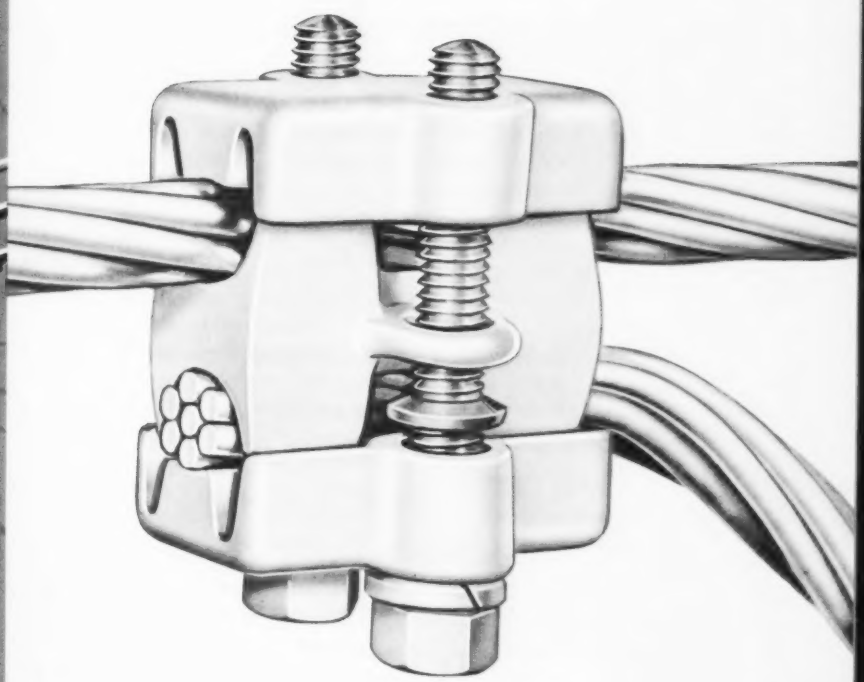
# Data Folder

FOR THE ELECTRICAL POWER AND LIGHT INDUSTRY

## ALL-ALUMINUM

# HEAVY DUTY CLAMPS

BULLETIN #6003



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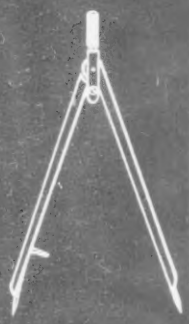
## ENGINEERED to save installation time



Designed for connecting aluminum to aluminum and aluminum to copper conductors hot or cold—and to meet Class A requirement of E.E.I. Tentative Specification 59-70.

One piece unit construction eliminates the handling of loose spacers, nuts and washers, reducing the number of parts to be handled by linemen, simplifying and speeding up installation.

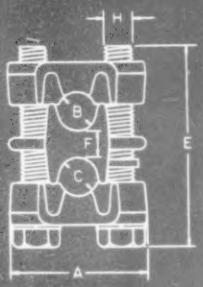
Large metal volume absorbs and dissipates cable heat losses, reducing the temperature of the connection. Heavy cross sections, particularly that of the spacer, give adequate separation of dissimilar conductors when used for bi-metallic connections. Heavy No-Ox-Id coating on spacer insures factory cleaned contact surfaces at job site.

Extra long bearing surfaces distribute clamping force over large area of conductor minimizing creep or cold flow of aluminum conductors. Bell mouthed castings guard against conductor damage. Components cannot rotate when conductor is being installed.

Provides all weather protection on aluminum or bi-metallic connections. Contact surfaces are guarded by rainshield design of castings. This feature prevents inhibitor "wash out" even under driving rain conditions. Condensation is drained off through ports in castings regardless of installation position.

Each clamp accommodates a wide range of conductors and provides full contact without distortion for all rated conductor sizes. Four 2-bolt clamps cover a conductor range from 6 to 795 ACSR on the main and from 8 to 395 ACSR on the tap. Three multi-bolted clamps cover a conductor range from 4 to 795 ACSR on main and tap.

## APPLICATION easily installed




Heavy duty all aluminum 2-bolt and multibolt clamps save installation time on aluminum and bi-metallic connections for—large transformer bank taps, voltage regular taps, heavy distribution and transmission line jumpers and taps.

These clamps may also be applied "hot". The clamps are easy to grip with any standard vise grip attachment for hot sticks. Time and motion studies indicate a substantial reduction of installation time over multipiece "U" Bolt connectors designed to do the same job. This is particularly true on hot line installations.

Many utility engineers have emphasized that 9 out of 10 connection failures on aluminum lines are accompanied by improperly installed connectors. Unit construction plus legible and positive identification of cable grooves on parts greatly aid linemen in proper connector application.

Operating experience and laboratory testing have shown that a good inhibiting paste, such as Blackburn CONTAX, greatly improves connector performance on aluminum conductors. When dissimilar conductors, such as copper and aluminum are being connected, it is imperative that an inhibiting paste be used to seal out moisture, thus preventing galvanic corrosion.

Blackburn's CONTAX has proven its merits under many diverse operating conditions and is strongly recommended.

All Blackburn heavy duty aluminum 2-bolt and multibolt connectors are available prefilled with CONTAX and sealed with an easily removed polyethylene cover.

## MATERIAL is strong and corrosion resistant

**Clamps are constructed of aluminum,** offering excellent thermal expansion and corrosion resistance characteristics.

**Caps and Pressure Plates**—are cast of high strength, corrosion resistant, non-copper bearing alloy 356-T6. Typical ultimate tensile strength 33,000 PSI.

**Spacers**—are cast of high conductivity, 99% minimum purity aluminum.

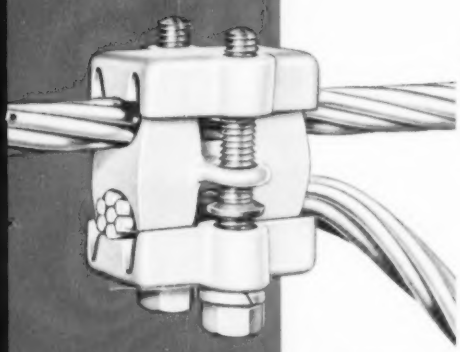
**Bolts**—are hex head, cold formed of high ultimate tensile strength aluminum alloy 2024-T4—68,000 PSI. Bolts are surface treated to prevent seizing.

**Lockwashers** prevent bolts from backing off, thus assuring a dependable, tight connection.

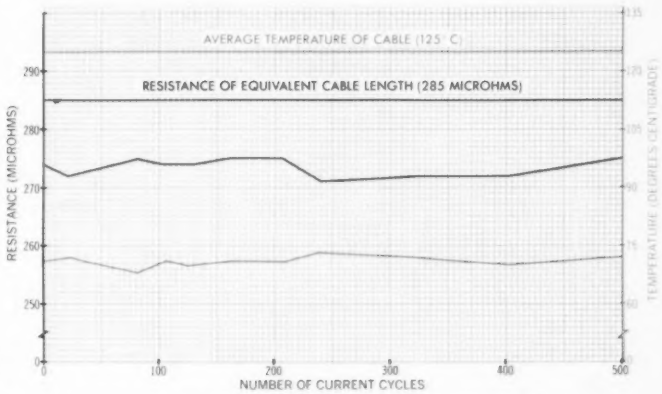
# PERFORMANCE

# TWO BOLT

## ELECTRICAL:



"2 A SERIES"


AVERAGE TEMPERATURE OF CABLE (125° C)
RESISTANCE OF EQUIVALENT CABLE LENGTH (285 MICROHMS)
RESISTANCE (MICROHMS)
TEMPERATURE (DEGREES CENTIGRADE)
NUMBER OF CURRENT CYCLES

**2A2 CURRENT CYCLING TEST CONDITIONS**

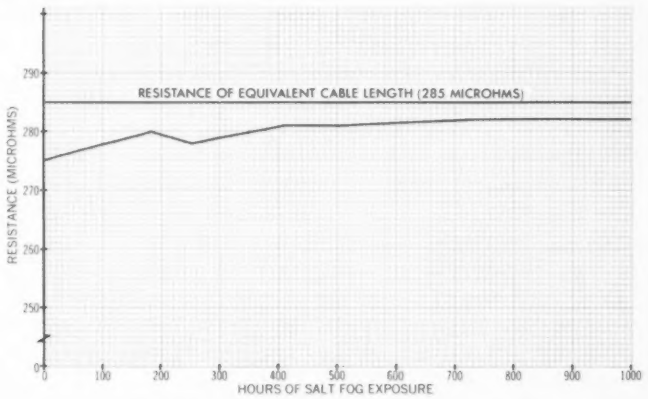
CONDUCTORS: 2 #2/0 (7 strand) aluminum. Wire-brushed before assembly.
TIGHTENING TORQUE: 144 inch-pounds, each bolt.
AMBIENT TEMPERATURE: 24.5° C.
CABLE TEMPERATURE: 125° C.
CYCLING CURRENT: 291 amperes, 1 hour "on", 1 hour "off".
COMPOUND USED: None.

Electrical resistance was measured by the potential drop method over the length of the connector during the "off" portion of a cycle.

Temperature was measured by means of a thermocouple imbedded in the connector.

All test conditions conform to E. E. I. Tentative Specification 59-70.

## CORROSION RESISTANCE:




**2A2 SALT FOG EXPOSURE TEST CONDITIONS**

TEST PROCEDURE: ASTM Standard B117-57T.
CONDUCTORS: 2 #2/0 (7 strand) aluminum. Wires brushed before assembly.
TIGHTENING TORQUE: 144 inch-pounds, each bolt.
COMPOUND USED: "Contax" applied to conductors before assembly.
MEASUREMENTS: Resistance was measured by the potential drop method over the length of the connector.

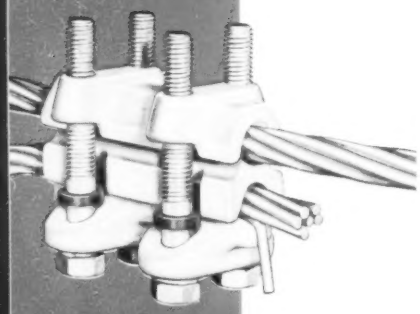
# ORDERING DATA

| Catalog Number | ACSR | | AWG | |
|---|---|---|---|---|
| | Main | Tap | Main | Tap |
| 2A2 | 2/0—8 | 2/0—8 | 2/0—8 | 2/0—8 |
| 2A4 | 4/0—8 | 4/0—8 | 4/0—8 | 4/0—8 |
| 2A5 | 397.5—4/0 | 336.4—4 | 500—4/0 | 397.5—4 |
| 2A9 | 795—397.5 | 397.5—4 | 1000—450 | 500—4 |

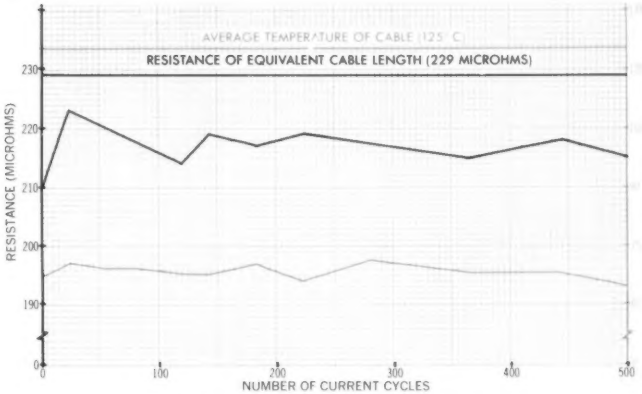
*See back page for Multi-Bolt information* ▶

# PERFORMANCE — MULTI-BOLT

## ELECTRICAL:



"4 B SERIES"




**4B4 CURRENT CYCLING TEST CONDITIONS**

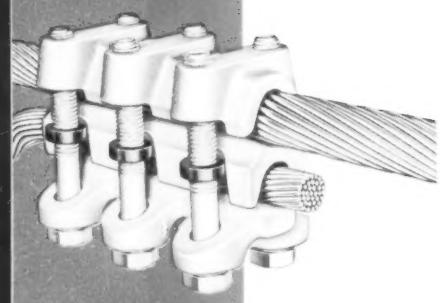
CONDUCTORS: 2 #336.4 MCM ACSR (18/1).
Wire-brushed before assembly.
TIGHTENING TORQUE: 300 inch-pounds, each bolt.
AMBIENT TEMPERATURE: 23° C.
CABLE TEMPERATURE: 125° C.
CYCLING CURRENT: 598 amperes, 1½ hours "on", 1½ hours "off".
COMPOUND USED: None.

Electrical resistance was measured by the potential drop method over the length of the connector during the "off" portion of a cycle.

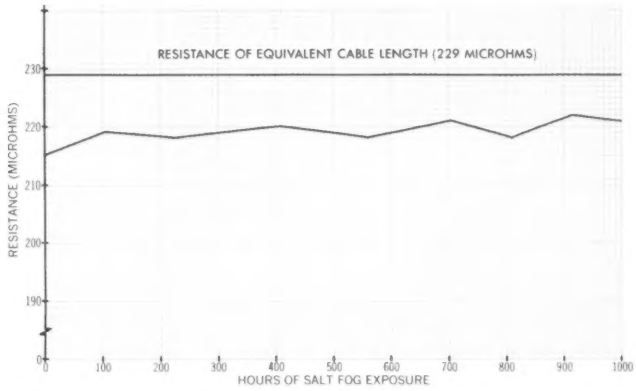
Temperature was measured using a thermocouple imbedded in the connector.

All test conditions conformed to E. E. I. Tentative Specification 59-70.

## CORROSION RESISTANCE:



"6 B SERIES"




**4B4 SALT FOG EXPOSURE TEST CONDITIONS**

TEST PROCEDURE: ASTM Standard B117-57T.
CONDUCTORS: 2 #4/0 (6/1) ACSR.
Wire-brushed before assembly.
TIGHTENING TORQUE: 300 inch-pounds, each bolt.
COMPOUND USED: "Contax" applied to conductors before assembly.
MEASUREMENTS: Resistance was measured by the potential drop method over the length of the connector.

## ORDERING DATA — 4B & 6B

| Catalog Number | ACSR | | AWG | |
|---|---|---|---|---|
| | Main | Tap | Main | Tap |
| 4B2 | 4/0—4 | 4/0—4 | 250—2 | 250—2 |
| 4B4 | 397.5—1/0 | 397.5—1/0 | 477—1/0 | 477—1/0 |
| 6B8 | 795—300 | 795—300 | 800—336.4 | 800—336.4 |

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## Business Plans For Capital Spending (Billions)

| | | Planned | | | |
|---|---|---|---|---|---|
| | 59 | 60 | 61 | 62 | 63 |
| Manufacturing | $12.07 | $15.24 | $14.16 | $13.33 | $13.62 |
| Commercial | 8.21 | 9.17 | 8.41 | 7.88 | 7.92 |
| Electric & Gas Utilities | 5.67 | 6.21 | 5.54 | 5.47 | 5.63 |
| Other Transportation & Communications | 4.69 | 5.17 | 4.66 | 4.34 | 4.35 |
| Railroads | 0.92 | 1.07 | 0.97 | 0.95 | 0.91 |
| Mining | 0.99 | 1.01 | 1.01 | 0.86 | 0.89 |
| All Business | $32.54 | $37.87 | $34.76 | $32.83 | $33.33 |

Source: McGraw-Hill Department of Economics

# A New Peak in Capital Spending

Report on
**Electrical Business Outlook**

**The nation's businessmen expect to lay out $37.9 billion for new plants** and equipment this year, an all-time high. Furthermore, they plan to continue spending at better than 1959 rates right through '63. Manufacturers plan to push most of their capital funds into more efficient means of production, for the most part ignoring capacity, which most consider ample. And research will be stepped up to introduce a multitude of new products in the early Sixties. These are major findings of McGraw-Hill's 13th Annual Survey of Business' Plans for New Plants and Equipment.

**This happy piece of news has a glad ring for business ears.** As a cushion for a nervous economy, record outlays for plants and equipment this year could go far to buttress crumbling hopes in many areas of business. But many disappointing indicators thus far, not the least being the uncertain gyrations on Wall Street, make these planned record outlays both a hopeful sign as well as something of an anomaly. Can we count on them? There is positive evidence that we can.

**The record size of spending plans this year** is no less encouraging than the pattern of their development. The first hint that heavier-than-usual capital spending lay ahead in 1960 came with McGraw-Hill's preliminary survey last fall. It showed that businessmen planned to step up their capital outlays 10% over 1959 levels. A later survey by the Commerce Department and Securities & Exchange Commission confirmed this, and revealed still more activity was in the works. Compiled in January and February, the study showed business spending plans had been revised upwards, this time to 14% over 1959 levels. And the final McGraw-Hill survey, run in late March and early April, showed business had raised its sights once again, to 16% over 1959 levels. At $37.9 billion, this volume of spending will carry 1960 capital outlays over the previous peak, set in 1957.

**Once past 1960, though, spending plans show a decline** back to near-1959 levels. However, plans for the following three years (1961-63) are preliminary, and incomplete in many cases. Spending could actually exceed current estimates

## Capital Spending – Modernization Is the Key

Percent of Capital Spending For:

| | 1959 Actual | | 1960 Planned | |
|---|---|---|---|---|
| Industry | Expansion | Replacement & Modernization | Expansion | Replacement & Modernization |
| Iron & Steel | 39% | 61% | 34% | 66% |
| Nonferrous Metals | 53 | 47 | 33 | 67 |
| Machinery | 31 | 69 | 37 | 63 |
| Electrical Machinery | 41 | 59 | 39 | 61 |
| Autos, Trucks & Parts | 11 | 89 | 12 | 88 |
| Transportation Equipt. (Airc't, Ships, R.R. Eq.) | 49 | 51 | 45 | 55 |
| Other Metalworking | 50 | 50 | 50 | 50 |
| Chemicals | 61 | 39 | 63 | 37 |
| Paper & Pulp | 37 | 63 | 49 | 51 |
| Rubber | 37 | 63 | 44 | 56 |
| Stone, Clay & Glass | 50 | 50 | 47 | 53 |
| Petroleum Refining | 18 | 82 | 9 | 91 |
| Food & Beverages | 41 | 59 | 31 | 69 |
| Textiles | 16 | 84 | 30 | 70 |
| Miscellaneous Mfg. | 55 | 45 | 46 | 54 |
| **ALL MANUFACTURING** | **37** | **63** | **35** | **65** |

Source: McGraw-Hill Department of Economics

in the next three years if plans are revised as they have been in the past. Experience shows that businessmen generally underestimate their capital outlays for periods longer than a year ahead.

**The utilities themselves figure heavily in the overall totals.** Electric and gas utilities will spend $6.2 billion this year for new facilities—only a few million less than their 1957 peak. And to meet growing power demands, electric utility expenditures will remain high throughout 1961-63, the survey showed.

**In manufacturing, efficiency is the focal point.** Companies plan to replace old machinery and modernize their plants, shooting for increased productivity and lower costs. This year, 65% of capital spending by manufacturers will go for replacement and modernization, while only 35% will go for expansion. These are almost the same proportions as in 1959. However, total spending by manufacturers last year was only $12 billion, compared to the $15.2 billion planned for this year. This means over $3 billion more will be spent for plant modernization in 1960.

**With all this emphasis on modernization,** manufacturers are planning to increase capacity only 5% this year. With the exception of '58, this is the smallest planned increase of the past 10 years. And this 5% figure will dwindle to a mere 4% a year for the following three years. The blame can be laid to excess capacity. Last year, factories were working at 85% of capacity, roughly one-tenth below the 94% rate that businessmen say they prefer. This situation will change, though, in the next few years. Manufacturers expect their sales to rise 8% this year, and an additional 17% by 1963. If these long run sales forecasts are realized, operating rates will approach preferred rates and will create a need for additional capacity by 1963.

**Research and Development, too, is being pushed harder than ever.** Research spending reached a record $9 billion last year, and a gain to $9.5 billion is planned for this year, with another step to $10.7 billion by 1963. The cost of bringing new products to market will chew up a substantial portion of manufacturers' R&D budgets. In fact, manufacturers estimate that 12% of the goods they sell by 1963 will be products that aren't available today, the McGraw-Hill survey revealed. Furthermore, close to two-thirds of the reporting companies indicated that a significant amount of their 1960 spending will be for facilities to make new products. This means the introduction of completely new processes, as well as new products, during the next three years.

**Regionally, the North Central manufacturers will spend the largest proportion** of the national total—30% in 1960 and 27% in 1961. But this is a declining share, less than in 1958 or 1959. Now, manufacturers are shifting an increasing proportion of their capital outlays to the West, which last year accounted for 13% of the U.S. total, with a planned increase to 15% this year, and a further climb to 17% indicated by 1961. Southern manufacturers will also increase their proportion of U.S. capital outlays in 1960 and '61. But the share of the New England and South Atlantic states will decline, while manufacturers in the Middle Atlantic states will go on spending about the same proportion of the national total as they have in recent years.

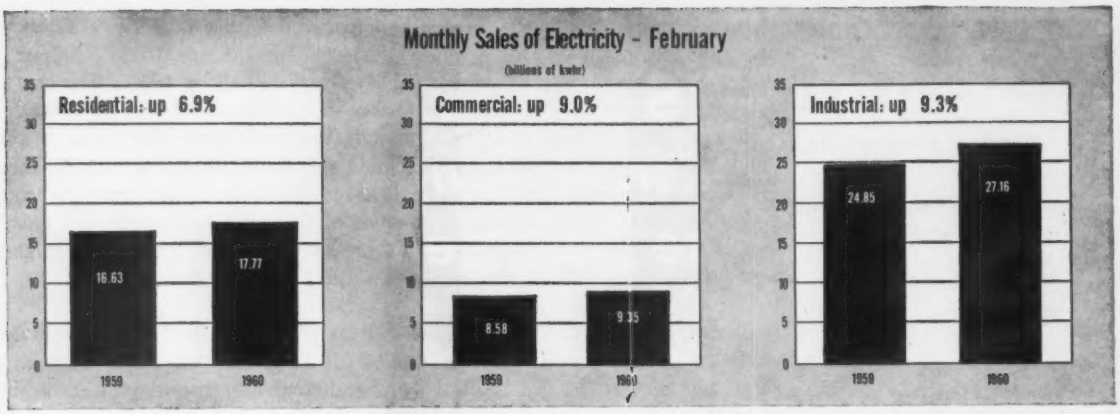
**For all business, depreciation allowances will stand out** as the primary source of funds for capital spending in 1960. Depreciation now equals about two-thirds of the total capital spending planned for this year. And depreciation will remain by far the largest source of funds in the future, forming a prop for the heavy capital expansion in years ahead. By 1963, U.S. corporations will have $24.8 billion available from annual depreciation charges—18% more than in 1959.

## How Will Capital Spending Affect the Utilities?

**What will these record outlays do to industrial load growth?** Any increase over the present growth trend would be only moderate. There will be only a hint of expansion this year in plant capacity—about 5%—with even less planned for 1961. And plant expansion is the master key to industrial load growth. The extreme emphasis on replacement and modernization, of course, will mean more automated processes, and more load. But how much more is questionable. Electric motors already power almost everything in industry. Motor load, in fact, accounts for about 85% to 90% of industry's power demands.

**Automation may even reduce the amount of horsepower a process requires.** In metalworking, for example, one automated drilling line can replace a number of individual drilling stations (much as one turret lathe replaced numerous individual engine lathes in the past). And although materials handling will probably stand out in modernization plans, its contribution to overall load may only be slight, involving, perhaps, a five horsepower conveyor to connect two existing 60-horsepower machines. Experience has shown that automation generally will increase load per factory man-hour, but may have little effect on overall plant consumption. Automation's big contribution to industrial load is more likely to be in making plant managers *think* modern.

**Two major power consumers, however, will expand capacity** significantly this year. The chemical industry will spend an average $1.7 billion a year for the next four years; about 63% of 1960's share going for expansion. Another big power user, pulp and paper, will devote about half of its $788,000 in capital outlays this year to expansion. But most other major power consumers—iron and steel, non-ferrous metals, and petroleum refining—will add to capacity at a slower than average pace.




## Power Statistics

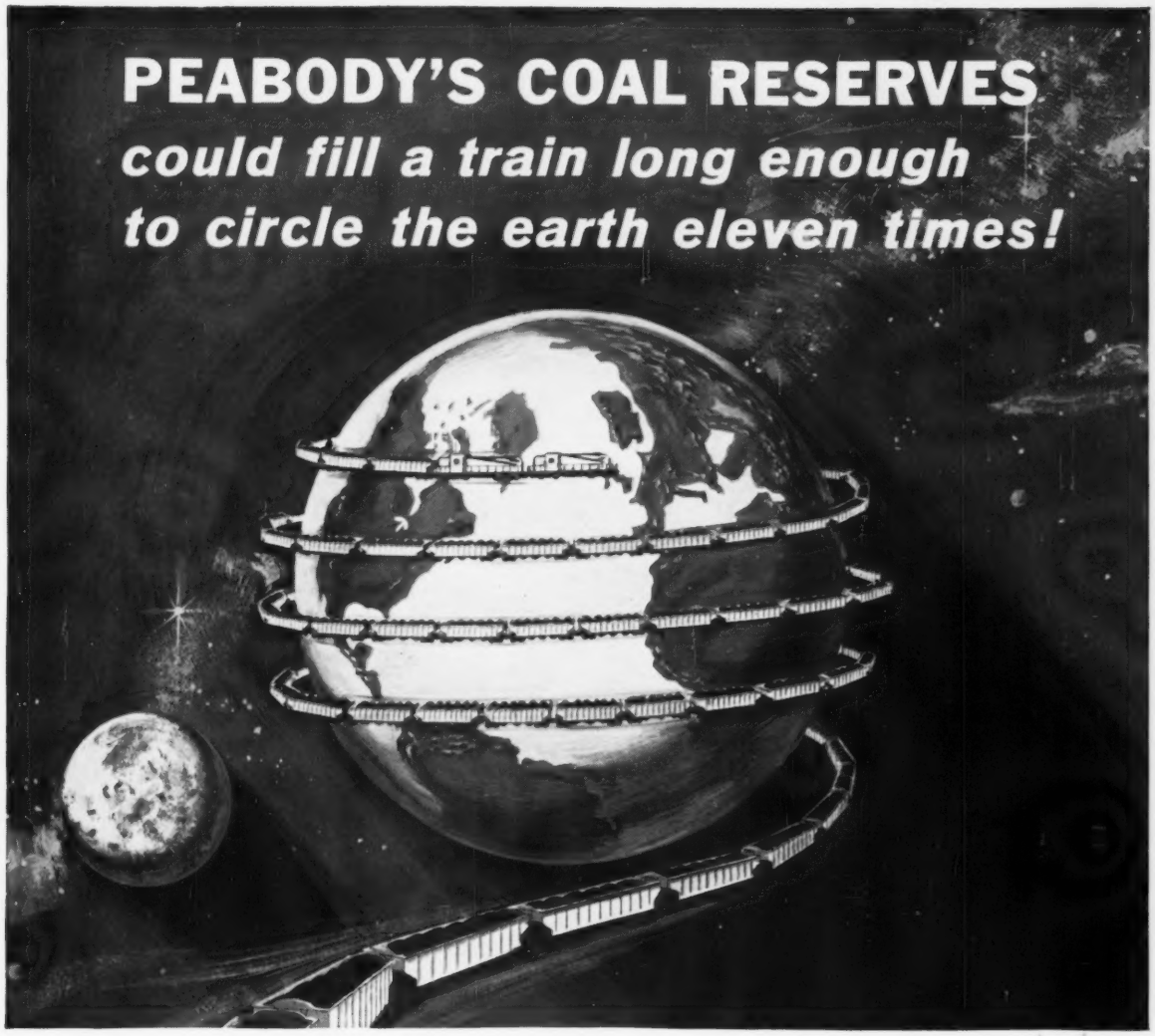
| | | Latest Month | Year Ago | Annual Change % |
|---|---|---|---|---|
| Capacity | Feb. | 158.22 | 144.52 | 9.5 |
| Est. Dec. '59 Peak (million kw) | | ..... | ..... | .... |
| Est. Dec. '60 Peak (million kw) | | ..... | ..... | .... |
| Production—billion kwhr | Feb. | 60.33 | 54.16 | 11.4 |
| Hydro | | 12.52 | 10.67 | 17.3 |
| Fuel | | 47.81 | 43.49 | 9.9 |
| Sales—billion kwhr | Feb. | 57.18 | 52.81 | 8.3 |
| Residential | | 17.77 | 16.63 | 6.9 |
| Commercial | | 9.35 | 8.58 | 9.0 |
| Industrial | | 27.16 | 24.85 | 9.3 |
| Other | | 2.90 | 2.74 | 5.8 |
| Fuel Consumption | Feb. | | | |
| Coal—million tons | | 15.22 | 14.21 | 7.1 |
| Oil—million barrels | | 8.52 | 8.85 | −3.7 |
| Gas—billion cu ft | | 98.40 | 81.77 | 20.3 |
| Net Income Class A & B Co's—$ million | Feb. | 170.30 | 165.26 | 3.0 |
| Residential Customers—millions | 12 mos. | 49.21 | 47.96 | 2.6 |
| Revenue per kwhr | ended | 2.50¢ | 2.53¢ | −1.2 |
| Avg kwhr per customer | Feb. 29 | 3,616 | 3,406 | 6.2 |
| Avg annual bill | | $90.40 | $86.17 | 4.9 |

## Business Statistics

| | | | | |
|---|---|---|---|---|
| Indexes: 1947–49 = 100 | | | | |
| FRB Industrial Production | Mar. | 167 | 160 | 4.4 |
| ENR Construction Cost | May | 171.9 | 165.7 | 3.7 |
| BLS Cost-of-living | Mar. | 125.7 | 123.7 | 1.6 |
| New Orders for Machinery (1950 = 100) | Mar. | 187 | 185 | 1.1 |
| NEMA Sales | | | | |
| Insulation materials | Feb. | 149 | 138 | 8.0 |
| Electric appliances | | 100 | 98 | 2.0 |
| Wholesale prices | | | | |
| Motors and generators | Feb. | 146.6 | 146.3 | 0.2 |
| Transformers and regulators | | 146.8 | 148.8 | −1.3 |
| Switchgear and fuses | | 176.1 | 171.9 | 2.4 |
| GNP—annual rate—$ billion | 1st qtr. | 498.0 | 470.4 | 5.9 |

**Significant changes:** The FRB Index of Industrial Production continues to slip from its January peak. But it is still 4.4% above year-ago levels. Most of the drop since January can be pinned on steel and autos.

# PEABODY'S COAL RESERVES
## *could fill a train long enough to circle the earth eleven times!*



## *This Tremendous Coal Reserve... Over Two Billion Tons ... Is Your Assurance of a Dependable Source of Fuel*

Imagine a train 200,000 miles long . . . over 38,000,000 hopper cars filled with coal . . . that's a lot of fuel! In terms of potential power, Peabody's coal reserves could light and power Chicago for 200 years. These vast reserves . . . strategically located near the nation's inland waterways—plus Peabody's efficient mining facilities . . . are your assurance of an economical supply of coal for years to come. And at Peabody's modern, automated Processing Plants, coal is tailor-made to get maximum efficiency from your burning equipment.

Whether you buy a carload or a trainload . . . your business is important to Peabody. Plan now to use this vast fuel reservoir. Call your nearest Peabody Office *today.*

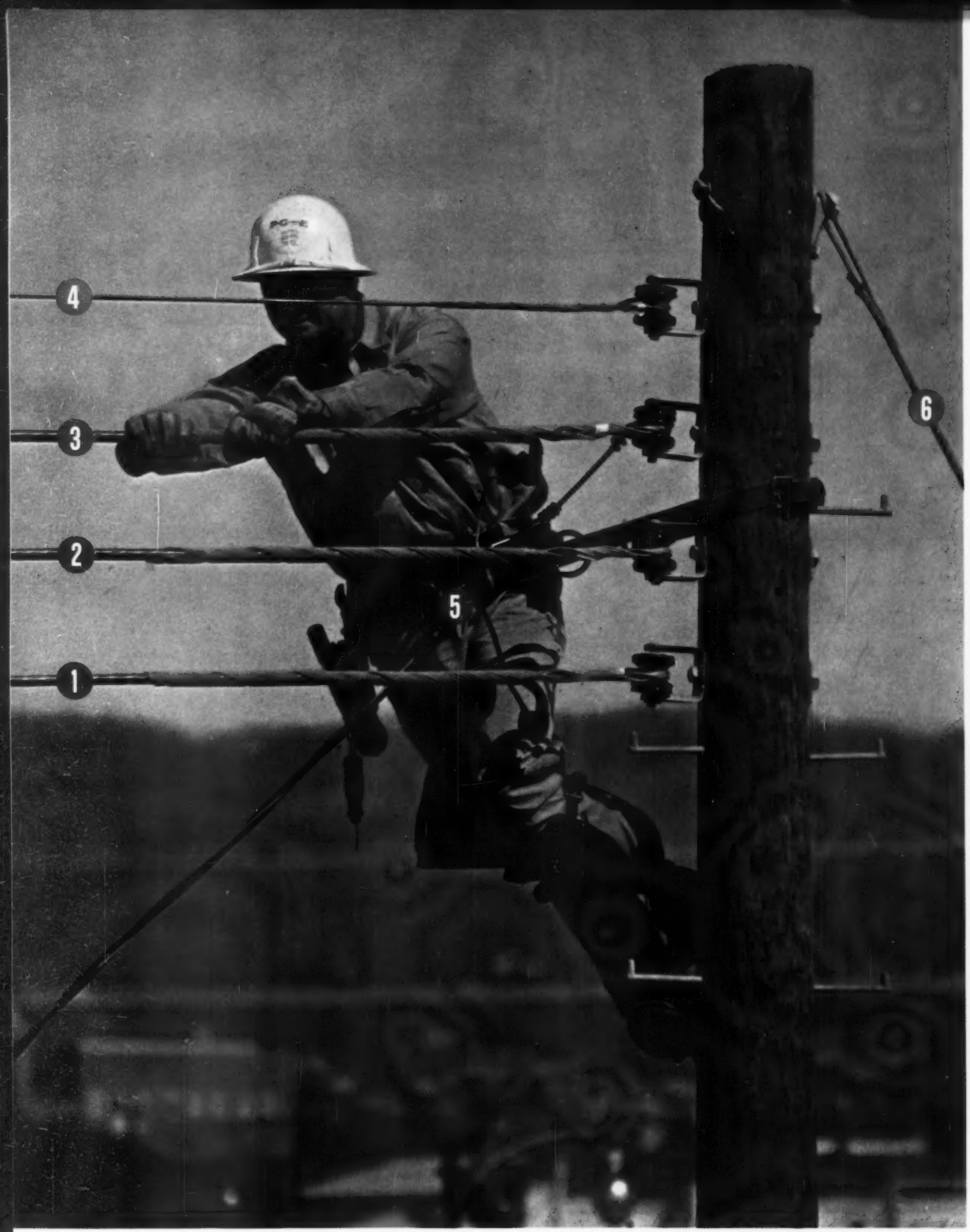
*Learn more facts about Peabody Coal . . . its importance to the nation's economy and your business. Send for Peabody's new FREE booklet, "COAL . . . ANCIENT STOREHOUSE OF MODERN LIVING." Write Department EW.*

power for progress

**PEABODY COAL COMPANY**

Peabody Plaza • 301 Olive Street • St. Louis 2, Missouri

*Offices In:* Chicago, Columbus, Des Moines, Detroit, Indianapolis, Kansas City, Louisville, Madison, Wis., Memphis, Minneapolis




**1 – 3** Preformed NADEs on secondary application—Polyethylene Covered All-Aluminum conductors, size 397.5 MCM being installed by Pacific Gas & Electric Company.

**4** Preformed NADE on Polyethylene Covered All-Aluminum street lighting circuit.

**5** Preformed Dead-End for Triplex bare neutral application.

**6** GUY-GRIP dead-end for $\frac{3}{8}''$ galvanized steel strand.

# USE *Preformed* TRADEMARK

# NEOPRENE-COATED DEAD-ENDS FOR WEATHERPROOF CONDUCTORS COVERED WITH NEOPRENE OR POLYETHYLENE

With *Preformed* TRADEMARK Neoprene-Coated Dead-Ends (NADEs), the jacketing on the conductor remains intact. Labor and potential corrosion problems are reduced. No bulky fittings to be taped.

**NO FEAR OF CAPACITANCE EFFECT,** which can break down the covering, thereby creating NOISE; also reduce the mechanical holding strength.

**NO STRIPPING OF THE COVERING,** therefore **NO EXPOSURE OF THE BARED CONDUCTOR TO CORROSION** from coastal or industrial contamination.

**NO DAMAGE TO CONDUCTOR JACKETING** from bending the conductor around the hardware.

**NO EMBEDMENT.** Low localized radial pressures are distributed over wide area to develop maximum holding strength.

**NO WEDGING DEVICES AND HIGH CONCENTRATED STRESSES.** Groups of individual wires, bonded together with Neoprene, create bands which gently grip the conductor along the entire contact length of the *Preformed* TRADEMARK Dead-End.

Tapping to conductor tails.

# ARE YOU WONDERING HOW MANY *Preformed* TRADEMARK NEOPRENE-COATED DEAD-ENDS HAVE BEEN PURCHASED DURING THE PAST THREE YEARS?

## Here's The Answer:

# 139 ELECTRIC UTILITIES have purchased nearly 300,000

**PREFORMED LINE PRODUCTS COMPANY**

5349 St. Clair Avenue • Cleveland 3, Ohio
600 Hansen Way • Palo Alto, California

is a trademark which is registered in the U.S. Patent Office and is the property of Preformed Line Products Company.

PREFORMED and GUY-GRIP are additional trademarks of Preformed Line Products Company.

Patented — U.S. Patent Number 2,761,273

# Floodlighting Helps Night Golfers

Golfers in Springfield, Mo., who find their game slipping because they can't get all the time in on the links they need, are now sharpening their backswings, putting, etc., in nighttime practice sessions, thanks to modern floodlighting.

A par-3 golf course there has been illuminated with 63 floodlights, permitting after-dark, mid-week outings. The type L-69 floodlights used have 1,500-w lamps.

The course, which has no hole longer than 205 yds, was opened last year. The greens and tees are illuminated to about 10 ft-c. Even the fairways, at about 5 ft-c, are twice as bright as many main streets in the country.

Most of the golfers who use the course are regular weekend players, but beginners are finding the course helpful for taking up the game. "These beginners might not even consider the game if it weren't for an opportunity to play at night," according to the course pro.

Springfield City Utilities estimates the total load for the entire system at 94 kw.

# Con Edison Program Rewires 150,000 Apartment Dwellings

A total of 150,000 apartment dwellings in New York have been rewired since Consolidated Edison Co of New York began its adequate wiring program six years ago.

Starting out slowly, the program has steadily picked up speed. For the first four years after the program began in 1954, only 1,000 apartment buildings were rewired. The second thousand took only 13 months. In the following seven months, the third thousand were rewired. The last thousand were rewired in five months.

Con Edison is now predicting that the next thousand apartment buildings will be rewired in no longer than four months.

Three reasons were given for the rapid growth of the program by J. O. Covington, manager of Con Ed's Adequate Wiring Bureau. He said, "There is a greater realization by more and more property owners of the necessity and benefits of adequate wiring; the entry of additional contractors in the adequate wiring field; and the higher rentals authorized by the Rent Commission, which make it economically attractive for an owner of any size or type of building to modernize his wiring."

Con Ed also reported on "enormous changes" in one and two-family houses. Of the 658,000 homes in the service area, almost 30,000 were rewired up through 1958. Last year, 10,000 houses were rewired.

### New Riser Capacity Increased

More than 25 million sq ft of rentable floor space were modernized in non-residential buildings since 1954. This area increased new riser capacity by over 70,000 kva, with a good portion of that contributed last year and the first quarter of this year.

Con Edison has established a 10-point program for its 1960 adequate wiring promotion. This includes: Ads in 35 newspapers, and nine realty and trade publications; three issues of the Wiring News; featuring an adequate wiring booklet on TV and radio; using billboards, car cards, and truck posters; TV and radio commercials; window displays and exhibits; showings of the "Magic Link" movie in schools; and placing adequate wiring feature stories in newspapers and publications.

## EEI Makes Plans for Food Service Council

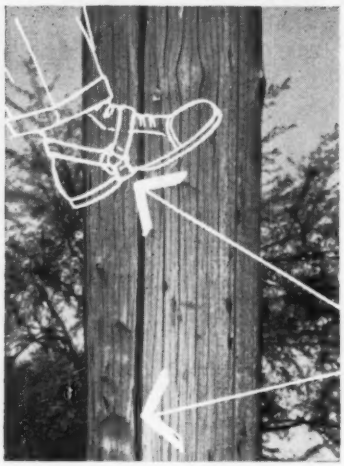
Edison Electric Institute will sponsor an Electric Food Service Council.

Its purpose: To assist manufacturers, distributors, dealers, and electric utilities in their individual promotional-educational programs.

As announced by E. O. George, chairman of the EEI Sales Division, "It is not the council's intention on its national or local level to replace any of the activities which individual companies are now carrying out." Rather its initial activity will be "examination of existing programs, determination at desirable improvements, and development of a wider and more effective use of them."

(*Continued on page* 136)

# CHECKS
and
# SPUR CUTS
are
# Prime Decay Spots



## and POLE SPRAYERS give them EXTRA ATTENTION

Older poles just naturally suffer from checks and spur cuts... trouble areas where moisture collects. This makes them vulnerable to the fungus decay condition known as "Shell Rot" which lessens pole life and impairs safety of linemen.

POLE SPRAYERS, INC. — Men, methods and materials — is a pioneer in the art of above-ground inspection and treatment for standing poles. Using proven preservatives, special attention and extra saturation is given to all critical areas. Fungus decay is stopped cold... reinfestation is prevented. Poles take on new life, last longer, costly replacements are delayed for years to come. Increased safety of your climbing personnel is assured.

You will be surprised to learn how little it costs to adopt an above-ground *Pole Spray* program. Get the facts. Write POLE SPRAYERS, INC., 991 Ellicott Street, Buffalo 9, N. Y.

**Pole Sprayers Inc.**

SERVING UTILITIES SINCE 1935


There will also be a national advertising program, George pointed out.

### Washington, D. C., to Get Improved Street Lighting

A six-year lighting program involving an annual capital outlay of about $450,000 has been approved for Washington, D. C., by city commissioners. The project will be carried out by Potomac Electric Power Co, and will involve higher lighting standards in four categories: Alleys, residential streets, arterials and freeways, and commercial and general business. Foot-candle levels will range from 0.1-0.2 for alleys, to 1.0-1.2 for commercial and general business areas.

Downtown business areas, federal monuments and the Georgetown section will be excluded from the relighting project.

New posts will be erected to stand no higher than 25 ft above streets where trees are planted.

## SELLING BRIEFS

**Electric carpet** producing 1,000 w has been made in England. An electric heating element is woven into the rug at 2-in. intervals. Makers claim it can be shampooed, vacuumed and withstand the weight of furniture.

Remote **air conditioning systems** with nominal capacities of 10 to 15 tons have been introduced by Westinghouse Electric Corp. Condensing units include high-capacity condenser coils on each side of the unit, and they have twin compressor systems, each with a matching fan and coil unit. Built-in time delay relay permits step starting.

Electrically driven **hand truck** for mechanized movement of heavy equipment such as appliances has been developed by General Electric Co. "Stair Cat" has 40-ft long cord which can be plugged into any 115-v household outlet. GE Form G motor drives two specially-designed heavy-duty rubber belts over the stairs, propelling the cart and load.

**Electric heating equipment** designed to be permanently installed as part of a building's heating system will be exempt from sales tax in Canada. The revision will permit "this method of household heating to compete for the market on the same terms as other methods," said Finance Minister Fleming.

A small, lightweight commercial **thermoelectric generator** which can reportedly produce electricity for a year on $10 of propane gas has been developed by General Instrument Corp. The generator produces 5 w of power, will run for approximately a year on a 50-gal tank of propane gas, and will sell for $500 when produced on a large scale.

Seattle City Light is offering a photoelectric cell-controlled **post lamp** to its residential customers. Customer may buy a post lamp fixture for $15, and have it installed within 35 ft of the house for another $50. To get the lamps into more general use, City Light is making the installation materials available to employees for $7. More than 250 were sold in the first 10 days.

**All-electric shopping center,** believed to be the largest of its kind in the Northwest, is being served by Portland General Electric Co. Twenty-seven "air-to-air" heat pumps have been installed on the roof to leave maximum floor space. Each unit is entirely automatic.

**Refrigerator - freezer** promotion package is being sponsored by Household Refrigerator and Freezer Section of National Electrical Manufacturers Assn. Promotion theme, "An electric refrigerator-freezer is a supermarket in your kitchen," is designed to dramatize the time and work-saving convenience of the multi-door combination units. Promotion package includes three-color streamer; three consumer folders; appliance dealer flyer; radio-TV spot announcements; and special issue of *Home Planning*, a syndicated newspaper clip-sheet.

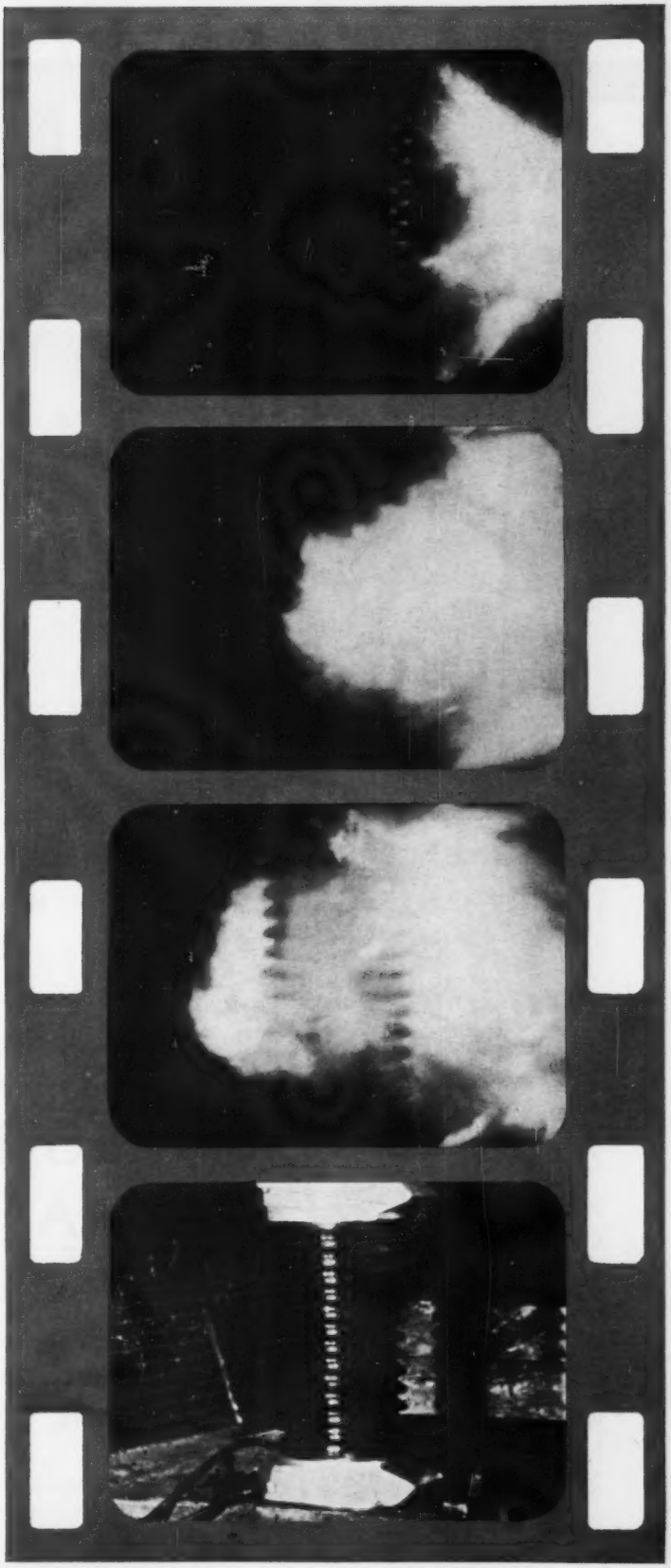
# 44,500 AMPS AND NO EXPLOSION

**Films show pressure relief arc transfer operating on new SVS arrester**

At the Westinghouse High Power Laboratory, the new SVS arrester was subjected to rigorous tests of its explosion-proof qualities. After the internal elements were deliberately damaged so that it could not clear, 44,500 rms symmetrical amperes were passed, and the new SVS remained physically intact.

This new pressure relief development on the Westinghouse SVS station-type lightning arrester provides unprecedented protection for your transformers and breakers.

Continued development and testing of Westinghouse Autovalve® lightning arresters positively eliminates explosions if arresters are damaged or encounter severe overloads. Consequential damage to valuable equipment is eliminated. For more information about this new development, turn the page.

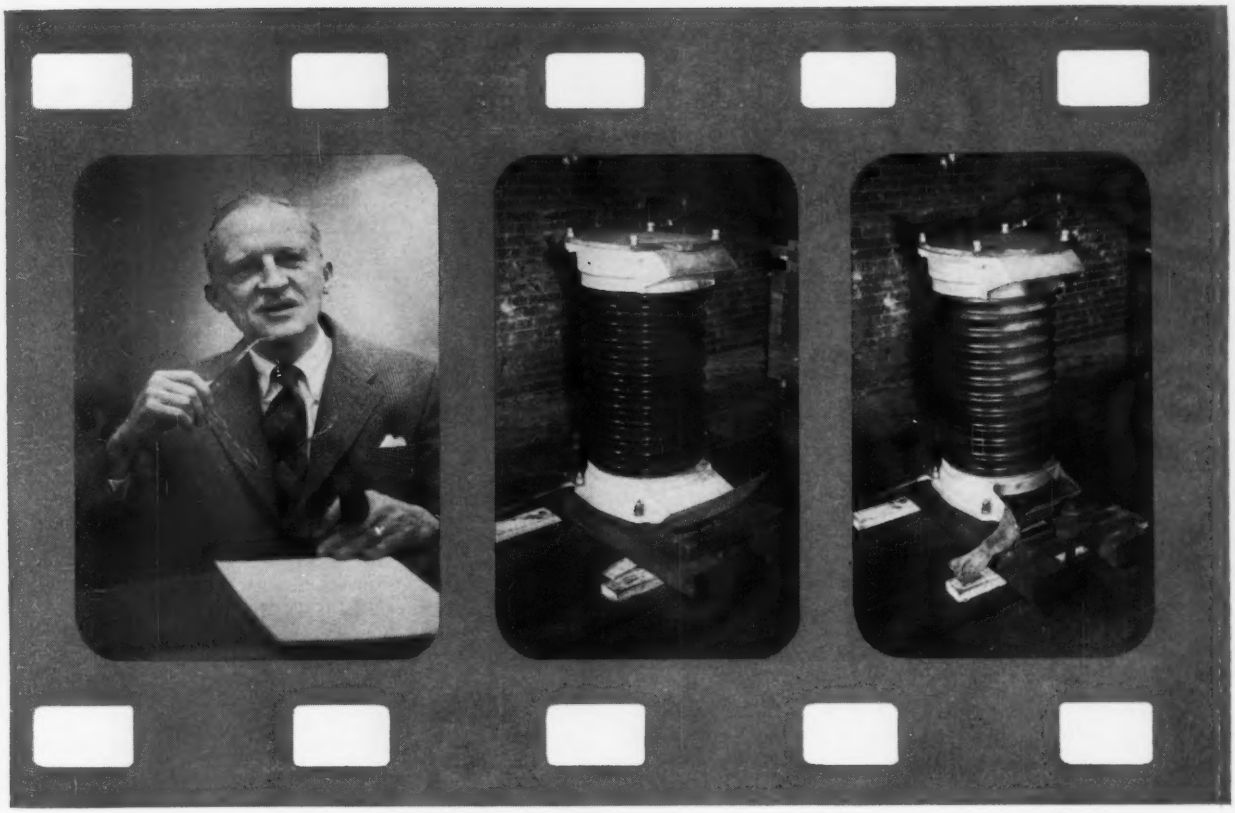


Film excerpts, from top to bottom, show the arrester at 30, 60 and 90 electrical degrees after the start of the fault current and intact immediately after the 10-cycle test.

J-60993-1

YOU CAN BE SURE...IF IT'S

Westinghouse



Edward Beck, lightning arrester research and design authority, reports—

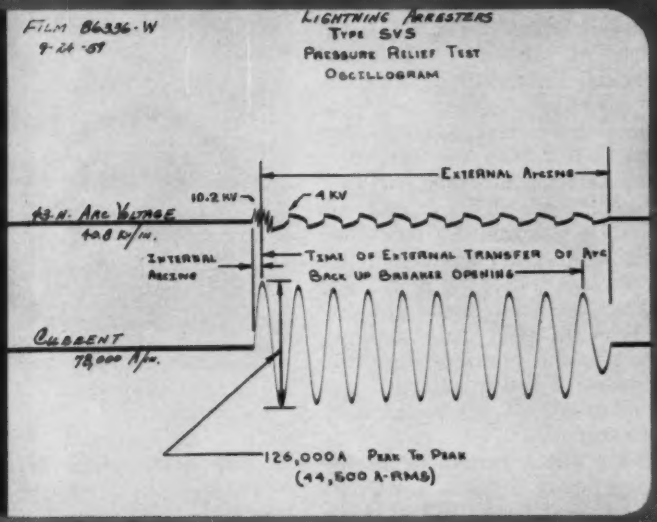
# "DELIBERATELY DAMAGED, NEW WESTINGHOUSE SVS ARRESTER IS TESTED AT 44,500 AMPS WITH NO EXPLOSION!"

"Occasional lightning arrester damage cannot be prevented entirely—**but explosions can,** with Westinghouse Autovalve lightning arresters.

J-60993-2

AT LEFT
a pre-failed arrester before and after the test.

AT RIGHT
an oscillogram made during the test. Note the test current of 44,500 amps. Within the first quarter of a cycle, the diaphragms broke and the arc transferred. Current continued for 10 cycles with no arrester explosion.




"The latest in this series of advanced, explosion-proof arresters is the 44,500-amp SVS station design—the highest fault rated arrester available.

"At Westinghouse, we have just completed fascinating tests on the new SVS proving it to be explosion-proof. To simulate actual service conditions, the gaps were shorted and the blocks were pre-punctured making certain the arrester would not interrupt the fault current.

"As shown on the oscillogram, the fault current was 44,500 rms symmetrical amps. The new SVS quickly relieved the tremendous internal pressure by switching the arc from the inside to the outside—a patented Westinghouse method of preventing arrester explosion. After the circuit was reclosed, the arrester remained intact. At the end of the tests, only the exterior porcelain was blackened and the diaphragms ruptured."

FOR MORE INFORMATION on the outstanding protection offered by the new 44,500-amp SVS lightning arrester, call your nearest Westinghouse salesman and ask him to show you the "Station Arrester Test Report" film.

J-60993-3

YOU CAN BE SURE...IF IT'S Westinghouse

# Besse Named President, Lindseth Chairman

Elmer L. Lindseth has been elected chairman of the board, and Ralph M. Besse, president, of Cleveland Electric Illuminating Co. As chairman, Lindseth will continue as chief executive officer, and Besse will remain the company's chief operating executive.

Lindseth joined the company in 1924. He was named a production engineer in 1927, assistant to the executive engineer in 1937, and technical assistant to the president in 1939. In 1941, he became assistant to the president, then vice president in 1942, executive vice president in 1945, and president the same year.

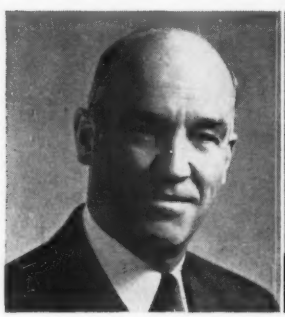
Besse was a partner in the law firm of Squire, Sanders, and Dempsey before joining CEI in 1948. He became executive vice president in 1953, and a director two years later.

LINDSETH

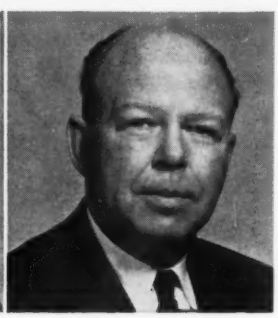
BESSE

In another appointment, Randall B. Luke was made assistant general counsel.

## Abbott Appointed VP-Operations; Gowdy Chief Engineer



ABBOTT



GOWDY

Charles T. Abbott has been named vice president of operations for New England Gas & Electric Service Corp. George H. Gowdy becomes chief engineer.

Abbott joined the System in 1930 and became chief electrical engineer in 1956. A graduate of Massachusetts Institute of Technology, Class of 1930, he is chairman of the Engineering and Operations Division of the Electrical Council of New England, and a member of the National Society of Professional Engineers.

Gowdy has been with the System since 1933, after graduation from Tufts College Engineering School. He has been chief mechanical engineer since 1956.

## Square D Elects Maechtlen President

Lawrence G. Maechtlen (photo) has been elected vice president of Square D Company. He succeeds Gordon Patterson who resigned.

Maechtlen, who had been executive vice president since 1958, joined Square D in 1926 as a draftsman, after graduation from California Institute of Technology. He then served in a number of positions including chief engineer, works manager, district manager, sales manager, and manager of the Western Division. He was named a vice president and director in 1951, and first vice president in 1957.

Patterson became president of Square D in 1955 when it acquired the Electric Controller & Manufacturing Co, of which he was president.

(*More News About People on page* 142)

# BARTLETT

More than 13 years ago Bartlett successfully pioneered the use of the helicopter for shade tree spraying—an operation that was to lead the way, a few years later, to a new efficient method of control of woody plants along utility rights-of-way.

At first, difficult terrains presented unusual problems but gradually through research and experience, new equipment was developed and new herbicides and techniques perfected to overcome them. Today, Bartlett research in this important field is carried on continuously through college fellowships and at the Bartlett Research Laboratories.

If your right-of-way clearance, line trimming, brush control or tree survey requirements present a problem, we invite you to share our years of experience. This service is now available from Maine to Florida, and west to Illinois and Alabama.

The Bartlett Way

# BARTLETT TREE EXPERTS

**Home Office, 2770 Summer Street, Stamford, Conn.**
Research Laboratories and Experimental Grounds, Stamford, Conn.
Bartlett School of Tree Surgery, Stamford, Conn.

**Harrison Hubard** has been appointed operating engineer at Virginia Electric & Power Co. Replacing him as chief system operator is **Dewey H. Winchester Jr.**

**Marion G. Miller,** vice president of West Penn Electric Co, has been elected to the board of directors of West Penn Power Co. **Vincent P. McDevitt,** vice president and general counsel, Philadelphia Electric Co, has been named a director of the company.

**George A. Hommell** has been appointed superintendent of the New Johnsonville, Tenn., Steam Plant.

**Cleo E. Thomas** has been made assistant to the president of California Electric Power Co.

**Joseph E. Theobald** has been elected assistant secretary, and **Robert E. McCormick,** assistant comptroller, at Dayton Power & Light Co.

British Columbia Power Commission has made the following district manager changes: **G. D. Coomes** to district manager at Nanaimo; **A. D. McGillivray,** district manager, Coastal region; **T. W. Humble,** district manager for Peace River at Dawson Creek; **J. S. Gardner,** distribution plant supervisor at Victoria; **Harvey N. Grier,** district manager at Duncan; **Blake A. Tweddle,** district manager at Terrace; **Eric W. Hall,** district manager, Smithers; **W. A. Best,** assistant district manager at Campbell River; and **T. A. Gillespie,** district manager at Williams Lake.

All U. S. Bureau of Reclamation hydro-power facilities and transmission systems in Wyoming and western Nebraska are now under the direction of **Ralph D. Asbridge** who has been named chief of the Power Division of the North Platte River projects.

**Marshall M. Koch** has been made a director of Black Hills Power & Light Co. Koch was with the Public Service Co of Colorado for 45 years.

General Electric Co has made the following appointments: **T. D. Daniels,** sales manager for the insulating materials department; **L. C. Coke,** special project engineer at the atomic products equipment department, San Jose, Calif.; **Alfred J. Brothers,** metallurgical unit, and **Leonard J. Isberg,** electromechanical unit, materials and processes laboratory, large steam turbine-generator department; **O. M. Raith,** sales specialist for the air conditioning and refrigeration industry, general purpose control department; **Lewis G. Zirkle,** manager of manufacturing, for heat processing equipment, industrial heating department, succeeding **Clarence M. Stevens,** who was recently made manager of manufacturing for the distribution assemblies department; **James E. Wilson,** manager-special heat processing, industrial heating department; **Richard A. Schaus,** manager-fuel processing engineering, atomic power equipment department; **William R. Smart,** marketing manager, distribution transformer department; **James L. Elrod,** manufacturing programming manager of that department; **Doyal E. McLemore,** manager of employee and community relations for the gear motor and transmission components department.

A major realignment has been made of marketing personnel in the GE meter department. Watthour meter and instrument transformer sales have been made into unified operations under two regional sales managers: **William S. Smith** and **Kenneth T. McEntire. James N. Thompson** succeeds Smith as manager of the resale operation.

Bechtel Corp has elected Vice President and Treasurer **Rudolf D. Grammater** to the board of directors.

Raytheon Co has elected **Charles F. Adams** chairman of the board and **Richard E. Krafve,** president. New vice presidents are **T. C. Wisenbaker, Paul F. Hannah,** and **George Ingram Jr.**

Allis-Chalmers Manufacturing Co has made the following appointments: **M. M. York** to manager of marketing in the Industrial Equipment Division; **Richard W. Fugill,** supervisory engineer, special control and regulator group; **Eugene R. Johnson,** supervisory engineer, metal working and mill control group; and **Rodney D. Dennis,** assistant to the manager, product sales, all in the control department. **Winfred A. Bezella** and **Gerald J. Walke,** of the nuclear power department, have been granted Atomic Energy Commission fellowships for a year's advanced study in nuclear science and related fields.

Westinghouse Electric Corp has named: **P. R. Sprowl,** manager of industry engineering, and **M. B. Wyman,** manager of service, after a division of the engineering and service activities of the apparatus products group; **Merrill S. Sancraint,** manager of wholesale and utility sales for the Lamp Division. Three directors have been appointed to head activities in the new business systems department: **Frank J. Carr,** director of business systems research and development; **Frank H. Muns,** director of business systems equipment; and **Robert C. Cheek,** director of business systems application. **Franklin S. Riley Jr** has been appointed director, consumer products public relations; **William G. Evans,** project manager for the thermoelectric program; **Edward D. Lynch Jr,** area sales manager in Buffalo, N.Y., for the apparatus marketing department; **L. J. Owsley,** regional marketing manager, and **M. J. McDonough,** regional electric utility and industrial products manager, both in the central apparatus sales region. **John D. Heasley** has been named manager of the industrial electronics department.

**Carl A. Pickering,** works manager of the Standard Control Division, has received the Westinghouse Order of Merit. **W. L. Thompson,** manager of supplier relations for Westinghouse, has retired.

**W. J. Clark** has been named sales manager for the Jasper Blackburn Corp. He had been assistant sales manager.

Ebasco Services Inc has made **M. L. Clough,** Northeast regional manager; **Edward A. Malinowksi,** senior industrial relations consultant; and **Howard Heffan,** a metallurgical engineer in the consulting engineering department.

Hot reheat pipe of new 325,000 KW unit No. 5 at Pacific Gas and Electric Company's Pittsburg Power Plant in California, showing line-up of 3 Grinnell Constant Support Hangers.

# Grinnell Hangers support piping at Pittsburg Power Plant

Grinnell manufactures a complete line of engineered pipe hangers and supports. Where reactive forces at terminal points must be kept within specified limits, Grinnell Constant Support Hangers are recommended. They are designed to provide an exact supporting force equal to the pipe load throughout the entire range of travel.

When pipe lines are subject to vertical movement and restrictive conditions do not require the use of a constant support type, Grinnell Variable Spring Hangers are recommended. They should be designed to support not less than 85% or more than 120% of the designed load for the total travel.

When necessary to prevent abnormal movement or vibration in pipe lines, Grinnell Sway Braces of the energy-storing, instant-acting, counter force type are available.

Grinnell maintains a staff of trained technicians; provides highly skilled assistance and advice right from the design stage; offers experienced field engineering service. Call on Grinnell next time. Grinnell Co., 277 West Exchange St., Providence 1, R. I.

Closeup of Grinnell Variable Spring Hanger supporting boiler feed pipe.

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Pipe Fittings, Valves, Pipe Hangers, Prefabricated Piping, Unit Heaters and Piping Specialties
Branch Warehouses and Distributors from Coast to Coast

# Tells MVEA Energy Studies Worth-While

## K.C. speaker says direct conversion to electricity has power possibilities

**HIGH TEMPERATURE,** says Dr John A. Hutcheson, Westinghouse, still poses formidable materials problems in direct conversion to electricity

However great, the effort and expense of experiment with the direct conversion of other forms of energy to electricity are justified, the engineering conference of the Missouri Valley Electric Association was told in mid-April at Kansas City, Mo.

Of the several possibilities, thermionic conversion appears to be the most advanced, said Dr John A. Hutcheson, Westinghouse Electric Corp. This is true, he continued, even though efficiencies so far have been low and the 3,500F temperature involves severe materials problems. He urged continuation of the experiments, even though the time when thermionic generators will replace central station power remains remote.

Operating temperatures of 4,500 to 5,000F cause materials problems with the magnetohydrodynamic (MHD) generator also, Hutcheson pointed out. But since this generator becomes attractive in sizes of 200 Mw and larger, he continued, it is logical for large power installations.

These new techniques—fuel cells, and thermoelectricity, along with those mentioned—in time, may reduce generating costs, and even a reduction of 1 mil per kwhr would save a half billion dollars a year at present production levels, he concluded.

Union Electric Co's Taum Sauk pumped storage project was planned to provide high head for maximum capacity at minimum investment, said that company's George Whitlow. The site, he said, provides wide vertical but small lateral separation of reservoirs and assures leak-proof construction and proximity to the service area. Thus, it has the advantage usually attributed to pumped storage, low capital costs, he said.

The lower reservoir, he said, is formed by a dam 60 ft high and 300 ft long; the upper reservoir being only 40 acres with a maximum depth of 110 ft. In the power house, two 175-Mw reversible pump-turbine units have a generating capacity of 350 Mw. Although storing 6,000 acre-ft, the lower reservoir floods only 370 acres, and the upper one is 800 ft above it.

H. G. Halley, Iowa Power & Light Co, described his company's newest development in residential underground distribution. It consists of a 7,620-v cable buried along rear lot lines, sectionalizing points along the lot lines, and high-voltage cables extending from the sectionalizing points to transformers adjacent to homes.

The transformer is a sealed unit, set on a concrete pad. It has a steel housing over it and its bushings. Plans are ready for 60 homes, Halley said.

A 20-year test schedule for Kansas City Power & Light Co meters manufactured since 1937 is not too far off, said L. W. Jones. Such testing, he said, is in accordance with the Missouri Public Service Commission's new regulations. In the past, the schedule called for tests every 12 years. He said that it is not unlikely that a time will come when meters lasting 40 years will be installed without tests and simply junked at the end of their lifetime.

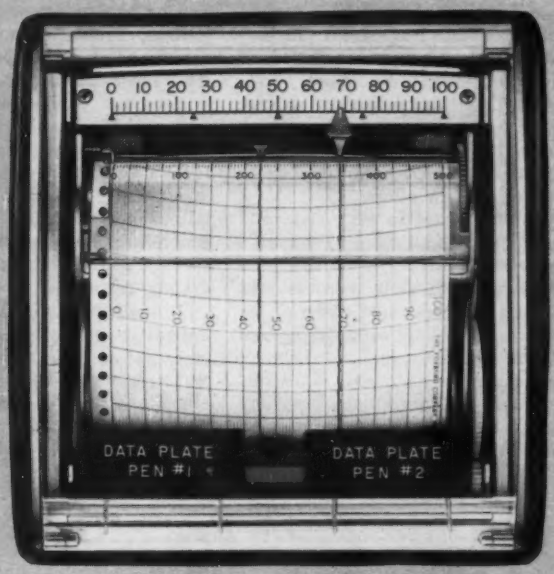
The Missouri PSC, he said, now permits the installation of meters manufactured since October 1959 without test by the power company.

Spacer-type cable costs slightly more than open wire distribution where tree trimming is not involved, said R. G. Steiner, Union Electric Co. His assertion was based on UE's experience with four experimental installations.

Spacer-type cable, he said, has advantages when it affords one or more of the following; reduced tree trimming, protection of phase conductors by the messenger, narrower easements, lower reactance, or improved appearance. The economics of two of the UE projects, he noted, favored spacer-type cable.

# another unit in Foxboro's **exclusive** 100% solid-state electronic Consotrol* system

## Simplest most reliable electronic recorder yet!

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Write today for Bulletin 21-10. It describes the new M/64 Recorder in detail, as well as the many other advanced instruments in Foxboro's complete 100% solid-state electronic control system. **The Foxboro Company, 245 Norfolk Street, Foxboro, Mass.**

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# Books

### Nuclear Physics Made Easy

*Sourcebook on Atomic Energy-2nd Ed.* By Samuel Glasstone. Published by D. van Nostrand Co, Princeton, N. J. 617 pages, illustrated. Price $4.40.

Dr Glasstone has added the developments of the eight years between editions to his thoroughgoing sourcebook on particle physics. A sampling of new material includes higher-powered accelerators, the isolation of elements through Nobelium (No. 102) and late theories about "strange particles." Famous names, from Leucippus on, cross and recross the pages to give this volume animation a scientific work seldom offers.

Glasstone writes in easy style and with logical organization. He makes comprehensive the more esoteric theories, reduced to their essences. In presenting this wealth of material, he has managed to stay within the grasp of the scientifically inclined layman, yet appeal to the engineer. Thus this sourcebook is appropriate for any reader seeking to introduce himself to particle physics.

### Surveys Sodium Reactors

*Sodium Graphite Reactors.* By Chauncey Starr and Robert Dickinson. Published by Addison-Wesley Publishing Co, Reading, Mass. 278 pages, illustrated. Price $6.50.

The authors, leaders in Atomic International's Sodium Reactor Experiment for the AEC, present a detailed resumé of that development, its background, research, problems and achievements. The approach assumes the reader has a good grounding in nucleonics. Sodium-graphite reactor materials, fuel, core components, installation and operation are among the factors examined closely. Individual apparatus is described in detail. The last chapter discusses sodium reactor generating plants, especially the design for the planned Hallam, Nebr., generating facility.

Though mathematical exposition is limited to one early chapter on nuclear physics, the technical treatment and narrow subject matter limit readership appeal to nuclear scientists and engineers interested in this type reactor.

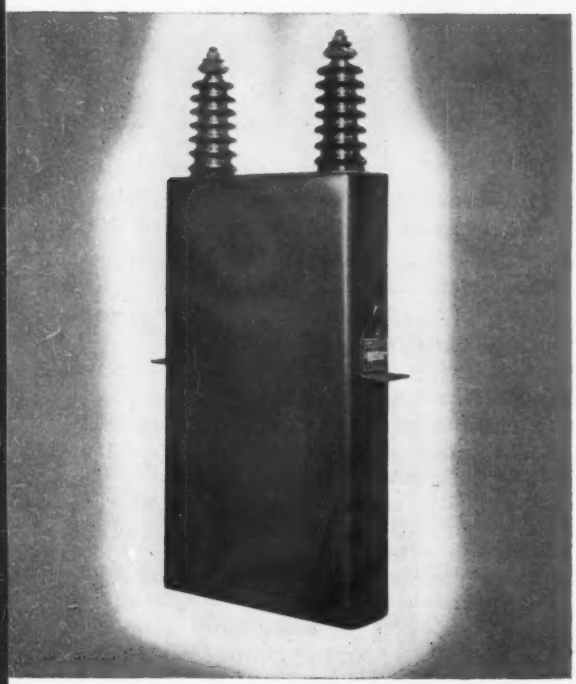
### Introduces Reactor Theory

*Nuclear Power Plant.* By E. Openshaw Taylor. Published by the Philosophical Library Inc, 15 E. 40th St, New York 16, N. Y. 179 pages, illustrated. Price $7.50.

Taylor presents succinctly the basics of reactor theory. He starts at the very beginning of the subject with elementary nuclear physics. By including only those factors directly relevant to reactors, after 61 pages he has plunged right into the heart of reactor engineering. Those mathematical concepts which are fundamental, a goodly number, appear through the book.

The condensation, however, with the briefest explanations of principles, with a minimum of illustrative examples, and trimmed of matter not of immediate concern to the nuclear engineer, restricts the appropriate readership. The book is quite lean for the engineer looking for a self-teaching book on reactor theory. It is too technical for those seeking an introductory survey of the field but lacking "some scientific background," which the author states is essential.


## G-E "COMPACT ISOKRAFT* 50" CAPACITORS OFFER



# 1200 KVAR, UP

General Electric's new "COMPACT ISOKRAFT 50" capacitors help speed equipment installation. These new 50-kvar units, the lightest and smallest available, make possible a switched 1200-kvar, three-segment cluster equipment weighing only 2300 lbs. Designed for installation flexibility, the equipment is suitable for installation in three segments or it can go up the pole in one piece. The heaviest segment weighs less than 900 lbs.

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## EEI Sees 7.5% Increase In U. S. Capacity in '60

By the end of 1960 the U.S. electric utility industry—both private and public—will add 12 million kw of new capacity. This will bring total generating capability to 170.5 million kw, with the 1960 additions representing a 7.5% increase.

This is one of the principal findings of the 27th semi-annual Electric Power Survey of Edison Electric Institute. Other highlights:

- The industry has 42 million kw scheduled, more than 90% of which will be on the lines by 1963.
- Electric energy output in 1960 is expected to reach 770 billion kwhr, or 8.8% more than the 707 billion kwhr recorded in '59.
- By the end of 1963, nation-wide kwhr output is estimated to hit one trillion. The installed capacity by December of that year is expected to be 203 million kw.
- Winter peak load for the U.S. (excluding Alaska and Hawaii) in 1960 is put at 133.6 million kw, 9.8% over 1959's 121.7 million.
- Winter peak for 1963 is forecast at 164.2 million kw. Gross margin is put at 23.6%.

## Polish Powermen in U. S.

As part of a U.S.-Poland cultural and technical exchange program, a group of six Polish power men is beginning a month-long visit.

The group will visit Edison Electric Institute and 10 electric utility companies. The Poles will also see the Shippingport and Enrico Fermi nuclear plants and inspect the facilities of three manufacturers.

Members of the Polish delegation are: E. Zadrzynski, Vice Minister of Power; M. Lech, General Director of the United Electrical Power Industry; B. Leszek, Director, Electrical Power Institute; S. Orzechowski, Electrical Power Construction Projects Bureau; Vice Director Z. Skoczynski of the Electrotechnical Institute; and B. Bartiszek, Southern District Electrical Power Works.

## Pumped Storage Project Construction to Start

Construction is now starting on the Smith Mountain pumped storage, hydroelectric project on the Roanoke River in Virginia. It will be the largest project of its kind in the country when completed in 1962.

Expected to cost about $50 million, the project includes a 227-ft-high concrete arch dam, and a second dam 18 river miles downstream. The upper generating plant will house four vertical shaft hydraulic turbines, including two that will be reversible to function as pumps. The lower plant will have two vertical shaft turbines. A provision for a fifth unit, of 140 Mw capacity, is in plans for the upper plant, which would bring ultimate total capacity to 580 Mw.

Appalachian Electric Power Service Corp, owner, received Federal Power Commission approval and license in late April. It is an American Electric Power subsidiary.


# IN ONE PIECE

connections between the three phases, line connections, plus control power connection for switched equipments are required in the field. Switched equipments include three, single-phase capacitor switches and a control wiring junction box mounted on the center segment.

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## Massachusetts Residents Question Reactor Safety

A proposed nuclear research center at Camp Edwards near Falmouth, Mass., would present "inevitable hazards," Dr Alan Butler, radiation safety authority at Massachusetts General Hospital in Boston, told a public meeting of more than 500 Cape Codders recently. Several scientists from the Woods Hole Oceanographic Institute concurred.

Before the session, however, the officers and directors of the Buzzards Bay Chamber of Commerce voted unanimously to reaffirm their position in support of legislation now pending before the Massachusetts Legislature. A bill would set up an Authority for a "Nuclear Park" in which private industry would conduct research.

Dr Butler told the meeting; "Someone has been trying to put something over on us by using the term 'park.' This would be a nuclear factory, with large amounts of radio-active waste. This type of chemical processing plant is the most dangerous aspect of the atomic energy industry." The disposal of atomic waste, he declared, "remains an unsolved problem throughout the world."

"It would take very little to ruin property values in the Cape area if the public became frightened," added Dr Butler.

Dr Alfred C. Redfield, senior oceanographer emeritus at Woods Hole, said the plant would require 250 million gallons of fresh water daily, which he asserted was 200 times the amount used by Falmouth in a day. Storage of atomic waste in underground tanks would threaten contamination of the area's water table, he said, with the possibility of leaks in the tanks from "even a slight earthquake, an explosion or a plane crash."

Andrew Bunker, Woods Hole metorologist, said there also would be danger of contamination of the air from vent stacks. The dampness and density of the Cape Cod air would add to this threat, he said "Meteorologically anything but favorable," was his verdict.

Dr Bostwick H. Ketchum, senior oceanographer at Woods Hole, insisted, "we don't know enough about disposal of atomic waste."


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## Students Get Introduction to Business

Attending the Annual Meeting of Stockholders of Atlantic City Electric Co were 30 high school senior class presidents who were special guests of the company. John Lloyd Jr, a director and company attorney, explained the workings of a free enterprise company, using his own as an example.

After the meeting the students toured the main office which was equipped with closed circuit television for the occasion. Henney Kilowatt, the company's experimental electric automobile, proved to be especially interesting to the student leaders.

A number of electric utility companies have instituted programs on the workings of the free enterprise system for high school students.

## Jones Says TVA Worth More Than Money Put Into It

The nation's taxpayers now own a power system worth more than $500 million more than they put into it.

A. R. Jones, director of the Tennessee Valley Authority, made the statement in addressing the Southwest Virginia Agricultural Assn. He said this was true because TVA has plowed $560 million of power proceeds back into the system to meet increased demands.

He said that amount is more than TVA would have paid the Treasury if cash interest had been required on all the national investment in the TVA power system.

"Transcending its purely financial aspects is the power system as a dynamic factor in the economy of the region and the nation as a bulwark of national defense," Jones said.

He also noted that estimated flood damage prevented in the Tennessee Valley is approaching the nation's tax investment in TVA flood control facilities. "Uncle Sam's investment in the TVA has brought returns which have fully justified that investment," he said.

A portion of the TVA investment will become private this year when TVA makes it first bond offering. Amount is expected to be about $50 million.

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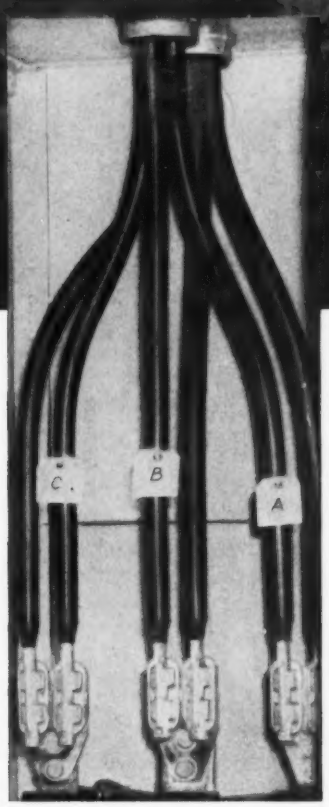


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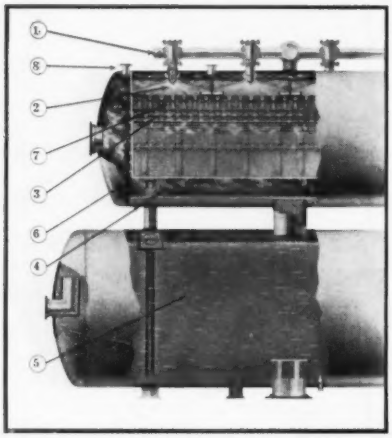


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But another basic reason is Worthington engineers who concentrate on deaerators. Working alongside of men designing pumps, condensers, ejectors—all the major components of the fluid handling group—these specialists have unparalleled experience in "system-matching". Very important, too, are our research facilities in which deaerators are continually on test.

In fact, Worthington has 105 years of experience that bears on fluid handling problems in both conventional and nuclear power plants. To draw on this experience —or just to talk deaerators—contact your nearest Worthington district office. Or write to Worthington Corporation, Section 45-17, Harrison, N. J. In Canada: Worthington (Canada) Ltd., Brantford, Ontario.

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